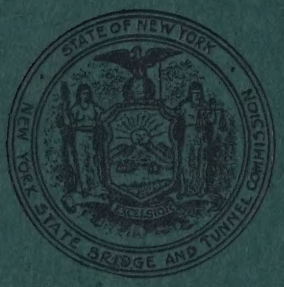
New York State Bridge and Tunnel Commission

AND

New Jersey Interstate Bridge and Tunnel Commission



The Holland Tunnel

CONTRACT NO. 19

ELECTRICAL EQUIPMENT

NEW YORK - - - NEW JERSEY

INVITATION AND INFORMATION FOR BIDDERS, SPECIFICATIONS, FORMS OF CONTRACT, BONDS AND CONTRACTOR'S PROPOSAL

FORM ADOPTED BY THE COMMISSIONS MAY 18, 1926, AND FILED ON COMMENCEMENT OF ADVERTISEMENT OF INVITATION AND INFORMATION FOR BIDDERS

1926

New York State Bridge and Tunnel Commission

AND

New Jersey Interstate Bridge and Tunnel Commission

The Holland Tunnel

CONTRACT NO. 19

ELECTRICAL EQUIPMENT

NEW YORK - - - NEW JERSEY

INVITATION AND INFORMATION FOR BIDDERS, SPECIFICATIONS, FORMS OF CONTRACT, BONDS AND CONTRACTOR'S PROPOSAL

FORM ADOPTED BY THE COMMISSIONS MAY 18, 1926, AND FILED ON COMMENCEMENT OF ADVERTISEMENT OF INVITATION AND INFORMATION FOR BIDDERS

1926

NEW YORK STATE BRIDGE AND TUNNEL COMMISSION

and

NEW JERSEY INTERSTATE BRIDGE AND TUNNEL COMMISSION

NEW YORK STATE BRIDGE AND TUNNEL COMMISSION

GEORGE R. DYER, Chairman

E. W. BLOOMINGDALE, Vice-Chairman

McDOUGALL HAWKES

A. J. SHAMBERG

ALBERT GOLDMAN
Commissioner of Plant and Structures of New York City

ROY G. FINCH
State Engineer and Surveyor

PAUL WINDELS, Counsel

MORRIS M. FROHLICH, Secretary

NEW JERSEY INTERSTATE BRIDGE AND TUNNEL COMMISSION

THEODORE BOETTGER, Chairman

JOHN B. KATES, Vice-Chairman

THOMAS J. S. BARLOW

JOHN F. BOYLE

ISAAC FERRIS

WELLER H. NOYES

ROBERT S. SINCLAIR

FRANK L. SUPLEE

ROBERT CAREY, Counsel

E. MORGAN BARRADALE, Secretary

OLE SINGSTAD
Chief Engineer

TABLE OF CONTENTS

Invitation and Information for Bidders.

The New York State Bridge and Tunnel Commission and the New Jersey Interstate Bridge and Tunnel Commission invite proposals to furnish and install the electrical equipment for the Holland Tunnel.

The Holland Tunnel consists of two tunnels. The north, or westbound tunnel, extends from the north side of Broome Street between Hudson and Varick Streets, Borough of Manhattan, New York City, to the east side of Provost Street at Fourteenth Street, Jersey City, New Jersey. The south, or eastbound tunnel, extends from the east side of Provost Street at Twelfth Street, Jersey City, New Jersey, to the west side of Varick Street at Canal Street, Borough of Manhattan, New York City.

The ventilation buildings are located as follows:

The land ventilation building, New York, on the west side of Washington Street between Canal and Spring Streets, New York City.

The river ventilation building, New York, just east of the New York pierhead line between Pier New 34, North River and Pier New 35, North River, as they now exist.

The river ventilation building, New Jersey, just west of the New Jersey pierhead line on the site of the new Erie Railroad pier now under construction.

The land ventilation building, New Jersey, in the Erie Railroad yard, just west of the New Jersey bulkhead and south of the center line of Twelfth Street, produced, Jersey City.

The administration building, New York, will be located on the west side of Varick Street between Canal and Vestry Streets, New York City.

The administration building, New Jersey, will be located on the southeast corner of Fourteenth and Provost Streets, Jersey City.

The New York entrance plaza is situated in New York City in the square bounded by Broome, Watts, Varick and Hudson Streets.

The New Jersey plazas are situated in Jersey City in Twelfth and Fourteenth Streets between Provost Street and Jersey Avenue and in Jersey Avenue between Twelfth and Fourteenth Streets.

The contract provides for the furnishing and installing of the equipment for lighting the tunnels, the open cut approaches, the New York entrance plaza, the New Jersey entrance and exit plazas and the ventilation buildings, for furnishing and installing traffic signals, telephones, switchboards for the control of oil switches and motors, control and power wiring, 440 volt truck type oil switches, distribution transformers, operating and protective relays, carbon monoxide recording apparatus, a complete supervisory system, equipment for charging electric truck batteries, miscellaneous testing equipment and storage batteries with their chargers for the operation of the oil switches, indicating lights, telephones and supervisory.

The contract also includes the installation, in the ventilation buildings, and connecting up of power transformers and 13,200 and 2,300 volt truck type oil switches which are being furnished under another contract, the drying out of transformers and the placing of a small amount of concrete in floors of the control rooms and in the New York administration building.

Bidders must examine the form of contract and the specifications and the contract drawings, must visit the location of the work, inform themselves of the conditions along the line of the work, and must make their own estimates of the facilities and difficulties attending the execution of the work.

The bidders' attention is particularly directed to the area in which the operations to be performed under this

contract are required to be carried on and to the necessity of allowing access to other contractors or persons for the purpose of performing their work, including, but not limited to, constructing the plazas, administration buildings and ventilation buildings, installing ventilating equipment and power cables, placing the tunnel finish, paving the tunnel roadway and other activities which may have to be prosecuted simultaneously with the work to be performed under this contract, and to the restricted area which may at times be available for the handling and storage of material in the tunnels and buildings.

Their attention is further directed to the requirement that all equipment must be guaranteed and that all defects developing in the equipment to be furnished and installed under this contract, due to faulty material, workmanship or installation, within a period of one (1) year after the final completion of this contract, shall be remedied by the Contractor without additional cost to the Commissions and that a bond must be furnished, as stipulated hereinafter, to cover such guarantee.

The contract requirements include provisions for an adequate plant, good quality of material and workmanship, the conduct of the work by methods most conducive to safety and the completion of the work within the time prescribed.

A more detailed description of the work to be done and other requirements, provisions, details and specifications are given in the form of contract and specifications, copies of which may be purchased at the office of the Commissions, Room 3004 Woolworth Building, 233 Broadway, Borough of Manhattan, New York City.

Partial payments to the Contractor will be made, as the work proceeds, as provided in the contract.

The Contractor will be required to begin work within fifteen (15) days after the date of the delivery of the contract and must complete all work as soon as practicable and within a period of seven (7) months after the date of the delivery of the contract.

Sealed bids or proposals will be received at the office of the Commissions, Room 3004 Woolworth Building, 233 Broadway, Borough of Manhattan, New York City, until the twentieth day of July, 1926, at one-thirty (1:30) o'clock P. M. Eastern Standard Time, at which time or at a later date, to be fixed by the Commissions, the proposals will be publicly opened. Proposals must be in the form prescribed by the Commissions.

The Commissions reserve the right, as stated in the contract, to make additions to, or deductions from, or deviations from the work under the various items for which lump sum prices are to be quoted in the Contractor's proposal.

Every proposal, when submitted, must be enclosed in a sealed envelope endorsed "Proposal for Furnishing and Installing the Electrical Equipment for the Holland Tunnel" and must be delivered to the Commissions or their Secretaries, and in the presence of the person submitting the proposal it will be deposited in a sealed box in which all proposals will be deposited.

No proposal will be received or deposited unless accompanied by two certified checks, for Twenty thousand dollars ($20,000) each, one payable to the order of the "Comptroller of the State of New York" and the other payable to the order of "The New Jersey Interstate Bridge and Tunnel Commission," and drawn upon National or State Banks or Trust Companies satisfactory to the Commissions, and having their principal offices in New York City or in the Cities of Newark or Jersey City. SUCH CHECKS MUST NOT BE ENCLOSED IN THE ENVELOPE CONTAINING THE PROPOSAL. A receipt will be given for these checks. Unless forfeited under the conditions herein stipulated such checks will be returned to the bidders upon surrender of the receipts at the time herein provided.

No proposal will be considered unless the consent to become surety for the faithful performance of the contract, in case the same is awarded to the bidder, as con-

tained in the Contractor's Proposal herein, is duly executed by two or more bonding or surety companies authorized to do business under the laws of the State of New York or the State of New Jersey or by two or more individuals. The corporations or individuals executing the consent must submit with the bid a detailed statement in affidavit form setting forth a list of their assets and liabilities. In order to be acceptable to the Commissions, the proposed sureties must show an excess of assets over liabilities in an amount equal to or greater than the proposed bond, which assets must consist either of improved real estate, first mortgages, bonds or stocks, approved by the Commissions.

No proposal, after it shall have been deposited with the Commissions, shall be withdrawn for any reason whatsoever.

The award of the contract will be made by the Commissions as soon as practicable after the acceptance of the bids and the contract will be awarded or all bids will be rejected within thirty (30) days after the opening of the bids, but the Commissions reserve the right to extend this time as in their opinion public interest may require.

The bidder whose proposal is accepted will be notified of such acceptance and whether the sureties proposed are approved by the Commissions.

If the sureties named in the proposal are approved by the Commissions, the bidder within five (5) days after such notification shall, in person or by duly authorized representative, attend at the said office of the Commissions, and such bidder, shall then deliver a contract in the form herein provided, duly executed and with its execution duly proved.

If the sureties named in the proposal are not approved by the Commissions, the bidder naming such sureties will be required to substitute other sureties approved by the Commissions within five (5) days after notice of such disapproval or within such further period, if any, as may be prescribed by the Commissions. Within five (5) days

after such approval, the bidder shall deliver the contract duly executed and approved in the manner stated above.

At the time of the delivery of the contract, the Contractor will be required to furnish security to the State of New York by depositing a bond in the sum of One hundred thousand dollars ($100,000) and security to the State of New Jersey by depositing a bond in the sum of One hundred thousand dollars ($100,000). These bonds must be in the forms annexed to the contract.

Deposits made by bidders whose proposals are not accepted will be returned within three (3) days after the contract is executed and delivered and its provisions in respect to the bonds are complied with, unless all proposals shall be rejected, in which event such deposits will be returned within three (3) days after such rejection. The deposit of the successful bidder will be returned when the contract is executed and its provisions in respect to the bonds are complied with.

To assist the Commissions in determining who is the lowest responsible bidder, the Commissions or the Chief Engineer may require the bidder to produce satisfactory evidence of his experience in the kind of work required under this contract and his ability to perform same.

On the part of the State of New Jersey any waiver affecting the time of advertisement and time of opening bids, the amount of the certified check or bond or any provisions relating thereto, or the time of the award, will be determined by the New Jersey Commission, with the consent of the State House Commission, as in their opinion the public interest may require.

No right shall be deemed to accrue to any bidder by reason of the submission of any bid hereunder, or by the waiver or non-enforcement of any provisions or requirement of the invitation.

The right to reject any and all bids is reserved.

CONTRACT.

CHAPTER I.

PREMISES.

Agreement, made this day of One thousand nine hundred twenty-six, between the New York State Bridge and Tunnel Commission, acting for and in behalf of the State of New York, and the New Jersey Interstate Bridge and Tunnel Commission, acting for and in behalf of the State of New Jersey, hereinafter called the "Commissions," parties of the first part, AND

hereinafter called the "Contractor," part* of the second part:

ENABLING RESOLUTIONS.

WHEREAS, the Commissions are authorized by law by the State of New York and the State of New Jersey, respectively, to construct a tunnel or tunnels under the Hudson River, one-half of the cost of which shall be paid by each of the respective States; and

WHEREAS, there has been set aside out of the moneys made available by the State of New York for the use of the New York State Bridge and Tunnel Commission and available for the purpose of this contract, the sum of

dollars ($)
and the said Commission has certified to the New Jersey

* Here and in like blanks hereafter insert "y" or "ies" as the case may be.

Interstate Bridge and Tunnel Commission, as follows, to wit:

New York Certificate.

"The New York State Bridge and Tunnel Commission hereby certifies to the New Jersey Interstate Bridge and Tunnel Commission, that it has available to the said New York Commission, for the purposes of the construction of a vehicular tunnel or tunnels under the Hudson River, the sum of

dollars ($)

for the purpose of paying out of the said sum hereby set aside its share, to wit, one-half of a certain contract for furnishing and installing the electrical equipment for the Holland Tunnel to be made by this Commission and the New Jersey Interstate Bridge and Tunnel Commission, parties of the first part and

part of the second part, dated the day of , 1926"; and

WHEREAS, there has been set aside out of the moneys made available by the State of New Jersey for the use of the New Jersey Interstate Bridge and Tunnel Commission and available for the purpose of this contract the sum of

dollars ($)

and the said Commission has certified to the New York State Bridge and Tunnel Commission as follows, to wit:

New Jersey Certificate.

"The New Jersey Interstate Bridge and Tunnel Commission hereby certifies to the New York State Bridge and Tunnel Commission that it has available to the said New Jersey Commission, for the purposes of the con-

struction of a vehicular tunnel or tunnels under the Hudson River, the sum of

dollars ($)
for the purpose of paying out of the said sum hereby set aside its share, to wit, one-half of a certain contract for furnishing and installing the electrical equipment for the Holland Tunnel to be made by this Commission and the New York State Bridge and Tunnel Commission, parties of the first part and

part of the second part, dated the
day of , 1926"; and

WHEREAS, the New York State Bridge and Tunnel Commission has adopted the following resolution:

New York Resolution.

"RESOLVED, that the New York State Bridge and Tunnel Commission, acting for and in behalf of the State of New York, pursuant to the authority vested in it by law, do enter into a contract jointly with the New Jersey Interstate Bridge and Tunnel Commission, acting for and in behalf of the State of New Jersey, as parties of the first part, with

part of the second part, for furnishing and installing the electrical equipment for the Holland Tunnel, which contract is to be dated the day
of , 1926; and be it further

"RESOLVED, that this Commission shall pay as its share of the said contract one-half of the amount determined to be due thereunder; and be it further

"RESOLVED, that this contract is deemed by this Commission to be necessary for the construction of the said tunnel or tunnels and to be included in the cost of said construction; and be it further

"RESOLVED, that this Commission shall cause to be set aside out of the moneys available to this Commission for the construction of said tunnel or tunnels the sum of

dollars ($)
to meet its share of said contract"; and

WHEREAS, the New Jersey Interstate Bridge and Tunnel Commission has adopted the following resolution:

New Jersey Resolution.

"RESOLVED, that the New Jersey Interstate Bridge and Tunnel Commission, acting for and in behalf of the State of New Jersey, pursuant to the authority vested in it by law, do enter into a contract jointly with the New York State Bridge and Tunnel Commission, acting for and in behalf of the State of New York, as parties of the first part, with

part of the second part, for furnishing and installing the electrical equipment for the Holland Tunnel, which contract is to be dated the day of , 1926; and be it further

"RESOLVED, that this Commission shall pay as its share of the said contract one-half of the amount determined to be due thereunder; and be it further

"RESOLVED, that this contract is deemed by this Commission to be necessary for the construction of the said tunnel or tunnels and to be included in the cost of said construction; and be it further

"RESOLVED, that the Treasurer of the State of New Jersey, as custodian of 'The State Highway Extension Fund,' set apart out of the said fund or out of the proceeds of the State Highway Extension Bonds the sum of

dollars ($)
for the purposes of this contract";

NOW, THEREFORE, in consideration of the mutual covenants and agreements hereinafter contained, the parties hereto do hereby for themselves, their heirs, executors, administrators, successors and assigns agree with each other as follows:

Limitation of liability.

This contract shall bind the State of New York and the New York State Bridge and Tunnel Commission for one-half only of the amount of money to be expended hereunder.

This contract shall likewise bind the State of New Jersey and the New Jersey Interstate Bridge and Tunnel Commission for the other one-half only of the amount of money to be expended hereunder.

This contract shall bind the respective States only to the extent of moneys available therefor, and no liability on account of this contract or obligation shall be incurred hereby by the respective States or Commissions beyond the moneys available for the purposes specified therein.

The Contractor admits that he is familiar with the laws of the State of New York and the laws of the State of New Jersey whereby the Commissions are authorized to construct a tunnel or tunnels under the Hudson River and that he is especially familiar with the authority, powers and limitations of authority and powers created or imposed by law upon the Commissions.

The invitation and information for bidders hereto attached, the Contractor's bonds, the proposal submitted by the Contractor and the contract drawings herein described are hereby made a part of this contract.

CHAPTER II.

GENERAL PROVISIONS AND DEFINITIONS.

Outline of contract.

ARTICLE I.—The Contractor agrees to furnish and install the electrical equipment herein described, together with all the work necessary therefor or incidental thereto. The States agree to pay to the Contractor the sums of

money hereinafter mentioned at the times and in the manner and upon the terms and conditions hereinafter set forth.

Marginal notes.

ARTICLE II.—Titles, headings, running headlines and marginal notes are printed hereon merely for convenience and shall not be deemed to be any part of this contract for any purpose whatever.

Definitions.

ARTICLE III.—The following words or groups of words used in this contract shall, unless the context clearly indicates another meaning is intended, be construed as follows:

"States."

(1) The word "States" to mean the State of New York and the State of New Jersey.

"Commissions."

(2) The word "Commissions" to mean the New York State Bridge and Tunnel Commission and the New Jersey Interstate Bridge and Tunnel Commission or the lawful successors of either or both of them.*

"Contractor."

(3) The word "Contractor" to mean the part of the second part to this contract and**

and any and every person or corporation who or which shall at any time be liable in the place of or for the part of the second part to perform any obligations under this contract assumed by the part of the second part. For convenience the Contractor is hereinafter referred to as if the Contractor were an individual. The word "he" shall, as the sense may require, include "she," "it" and "they"; the word "him" shall include "her," "it" and "them"; and the word "his" shall include "her," "its" and "their."

* Whenever the term "States" or "Commissions" is used as referring to one of the contracting parties, the same shall be taken to mean the parties of the first part to this contract.

** Here insert, as the case may be, either "its successors," or "his executors," "administrators," or "their successors," or "their executors," "administrators."

"Comptrollers." (4) The word "Comptrollers" to mean the Comptroller of the State of New York and the Comptroller of the State of New Jersey and the officers or board or boards to whom or to which their powers may hereafter appertain.

"Engineer." (5) The word "Engineer" to mean the Chief Engineer of the Commissions or his duly authorized representative or successor.

"Tunnel." (6) The word "Tunnel" to mean that part of the Holland Tunnel (formerly known as the Hudson River Vehicular Tunnel) in which the Contractor herein agrees to install the electrical equipment under this contract.

"Holland Tunnel." (7) The words "Holland Tunnel" to mean the whole work connected with the Holland Tunnel Project.

"Notice." (8) The word "notice" to mean a written notice.

"Directions, etc." (9) The words "directed," "required," "permitted," "ordered," "designated," "prescribed," or words of like import, used in the specifications or upon the drawings, to mean, respectively, the direction, requirement, permission, order, designation or prescription of the Engineer, and similarly the words "approved," "acceptable," "satisfactory," or words of like import, used in the specifications or upon the drawings, to mean, respectively, approved by, or acceptable or satisfactory to, the Engineer.

"Works." (10) The word "Works" to mean all the matters and things herein agreed to be furnished or done by or on the part of the Contractor.

"City." (13) The word "City" to mean City of New York or City of Jersey City, as the case may be.

"Inspector." (15) The word "Inspector" to mean any representative of the Engineer designated by him to act as inspector.

"Electrical Equipment." (16) The words "Electrical Equipment" to mean all the lights, control equipment, telephone system, traffic signals

and supervisory system, including all the wiring therefor, which the Contractor herein agrees to furnish and install and all work incidental thereto and the power transformers and oil switches which the Contractor herein agrees to install under this contract.

Contractor's address.

ARTICLE IV.—The Contractor hereby designates room number on the floor of the building number

in the City of New York, or room number on the floor of the building number

in the City* of , New Jersey, as the place where all notices, directions and other communications may be served, mailed or delivered. The delivery at the aforesaid place or deposit in a postpaid wrapper directed to the aforesaid place, in any post office box regularly maintained by the Post Office Department, of any notice, direction or other communication to the Contractor shall be deemed to be sufficient service thereof upon the Contractor as of the date of such delivery or deposit. The said address may be changed at any time by an instrument in writing executed and acknowledged by the Contractor and delivered to the Commissions. Service of any notice, direction or other communication may also be made upon the Contractor personally, or if the Contractor be a corporation, upon any officer or director thereof. The office of the Commissions, until further notice, will be Room 3004 Woolworth Building, 233 Broadway, Borough of Manhattan, New York City.

Liability for acts of subcontractor and his employees.

ARTICLE V.—If the Contractor shall cause any part of this contract to be performed by a subcontractor, the obligations to perform the work under the provisions of this contract shall apply to such subcontractor and his officers, agents and employees in all respects as if

* The latter shall be a city within the counties of Hudson or Essex.

he and they were employees of the Contractor; and the Contractor shall not in any manner thereby be discharged from his obligations and liabilities hereunder, but shall be liable hereunder for all acts and negligence of the subcontractor, his officers, agents and employees as if they were employees of the Contractor. The employees of the subcontractor shall be subject to the same provisions hereof as employees of the Contractor; and the work and material furnished by the subcontractor shall be subject to the provisions hereof as if furnished directly by the Contractor.

Chief Engineer representative of Commissions.

ARTICLE VI.—The representative of the Commissions on the Works shall be their Chief Engineer or his duly appointed representative or successor who shall direct the work of the Contractor and with whom the Contractor shall deal.

Approval of orders for materials and subcontracts.

ARTICLE VII.—The Contractor before ordering any material shall state in writing to the Chief Engineer for approval the name of the person, firm or corporation from whom such material is to be purchased, their place of business and the materials which they are to furnish and such other information as may be required. The Chief Engineer shall have the right to require the Contractor not to place any order for material with any person, firm or corporation disapproved of by him. Consideration will be given only to manufacturers who have been successfully manufacturing the types of equipment to be furnished, for at least five (5) years. In the case of subcontracts for a portion of the work, the Contractor shall make a similar statement in writing to the Commissions for approval, and the Commissions shall have the right to require the Contractor not to award subcontracts to any person, firm or corporation disapproved of by them.

Assignment of contract prohibited except by permission of Commissions.

ARTICLE VIII.—The Contractor shall not assign, transfer, convey, sublet or otherwise dispose of this contract or of his right, title or interest therein or any part there-

of or of his power to execute such contract to any other person, company or corporation without the previous consent in writing of the Commissions; and he shall not assign, whether by power of attorney or otherwise, any of the moneys to become due and payable under this contract unless by and with like consent. If the Contractor shall, without such previous written consent, assign, transfer, convey, sublet or otherwise dispose of this contract or of his right, title or interest therein or any part thereof, or his power to execute this contract, or any of the moneys to become due and payable under this contract, to any other person, company or corporation, this contract may, at the option of the Commissions, be revoked and annulled and the States shall thereupon be relieved and discharged from any and all liability and obligations growing out of this contract to the Contractor and to the person, company or corporation to whom he shall assign, transfer, convey, sublet or otherwise dispose of the same, and the said Contractor and his assignee, transferee, or sublessee, shall forfeit and lose all moneys theretofore earned under this contract except so much as may be required to pay his employees; and no right under this contract or to any money to become due hereunder shall be asserted against the States, at law or in equity, by reason of any so-called assignment of this contract or any part thereof or of any moneys to grow due hereunder unless authorized as aforesaid by the written consent of the Commissions; provided that nothing herein contained shall be construed to hinder, prevent or affect an assignment by the Contractor for the benefit of his creditors made pursuant to the laws of the State of New York or the laws of the State of New Jersey.

Labor law and workmen's compensation.

ARTICLE IX.—The Contractor agrees to comply with the provisions of any laws of the State of New York and of the State of New Jersey relative to the compensation, hours of labor, conditions of employment of any laborer,

workman, or mechanic employed by him, and especially Chapter 36 of the Laws of 1909, State of New York, and Chapter 95 of the Laws of 1911, State of New Jersey, so far as the said laws may be applicable thereto.

Labor laws, etc.

The Contractor agrees to abide by any rule or order of any board or official authorized or directed by law to enforce provisions of any law of the State of New York, or of the State of New Jersey relating to hours of labor, or conditions of employment of any laborer, workman, or mechanic employed by him hereunder, so far as the said law may be applicable thereto.

Provisions deemed inserted.

ARTICLE X.—Each and every provision of law required to be inserted in this contract should be, is and is deemed to be inserted herein, and if, through mistake or otherwise, any such provision is not inserted or is not correctly inserted, then this contract shall forthwith, upon the application of either party, be amended by such insertion so as to comply strictly with the law without prejudice to the rights of either party hereunder.

Unlawful provisions void.

ARTICLE XI.—If this contract contains any unlawful provision not an essential part of the general structure of the contract and which shall not appear to have been a controlling or very material inducement to the making thereof, the same shall be deemed of no effect and shall, upon the application of either party, be stricken from this contract without affecting the binding force of the contract as it shall remain after omitting such provision.

Members or employees of Commissions not personally liable.

ARTICLE XIII.—No claim shall be made by the Contractor against any member, officer, agent or employee of the Commissions personally, under or by reason of this contract or any matter arising therefrom or any of its articles or provisions or of anything ordered or required hereunder.

CHAPTER III.

WORK TO BE DONE, PRICES, ETC.

Work to be done.

ARTICLE XIV.—The Contractor shall furnish all the labor and materials, plant, power, tools, equipment, supplies and other means necessary or proper for furnishing and installing the electrical equipment in the manner and within the time hereinafter specified. He shall complete furnishing and installing the electrical equipment and do all work and furnish all labor and materials required for such furnishing and installing to the satisfaction of the Commissions and in accordance with the plans, contract and specifications and at the prices herein agreed upon and fixed therefor. There are included within his obligation under this Article, as essential features thereof, the provision of plant adequate in all respects to insure the progress of the furnishing and installing of the electrical equipment according to the best rules and usages of such work; the employment of methods best adapted to insure the best grade of work, also the remedying of all defects developing in the equipment to be furnished under this contract, or its appurtenances, or the installation work to be performed under this contract, due to faulty material, workmanship or installation, for a period of one (1) year after the date of the final completion of this contract.

Payment to Contractor.

ARTICLE XVI.—The States shall pay, and the Contractor shall receive, in full compensation for furnishing and installing the electrical equipment for the Tunnel and for all expenses in connection therewith or incidental thereto, including the furnishing of all labor, materials, plant, power, tools, appliances, equipment and supplies, and for all loss and damage arising out of the nature of the work aforesaid or from the action of the elements or from any unforeseen obstruction, difficulty or delay encountered in the prosecution of the work and for all risks of any description connected with the work, the co-ordi-

nation of his work with that of other contractors or persons, and for all expenses incurred by or in consequence of the suspension or discontinuance of the work as herein specified, and for the remedying of all defects developing in the equipment to be furnished under this contract, or its appurtenances, or the installation work to be performed under this contract, due to faulty material, workmanship or installation, for a period of one (1) year after the date of the final completion of this contract, the prices contained in the following Schedule:

SCHEDULE ITEMS.

Item 195.—For the tunnel lighting, complete, the lump sum of

dollars ($).

Item 196.—For the New York entrance plaza and New Jersey entrance and exit plaza lighting, complete, the lump sum of

dollars ($).

Item 197.—For the telephone equipment, complete, the lump sum of

dollars ($).

Item 198.—For the lighting and electric heating in buildings and shafts including passages, as follows:

(a) For the land ventilation building and shafts, New York, the lump sum of

dollars ($).

(b) For the river ventilation building and shafts, New York, the lump sum of

dollars ($).

(c) For the land ventilation building and shafts, New Jersey, the lump sum of

dollars ($).

(d) For the river ventilation building and shafts, New Jersey, the lump sum of

dollars ($).

Item 199.—For the power and control wiring and power and lighting transformers in buildings and shafts, as follows:

(a) For the land ventilation building and shafts, New York, the lump sum of

dollars ($).

(b) For the river ventilation building and shafts, New York, the lump sum of

dollars ($).

(c) For the land ventilation building and shafts, New Jersey, the lump sum of

dollars ($).

(d) For the river ventilation building and shafts, New Jersey, the lump sum of

dollars ($).

Item 200.—For the control switchboards, storage batteries and concrete floors in control rooms as follows:

(a) For the land ventilation building, New York, the lump sum of

dollars ($).

(b) For the river ventilation building, New York, the lump sum of

dollars ($).

(c) For the land ventilation building, New Jersey, the lump sum of

dollars ($).

(d) For the river ventilation building, New Jersey, the lump sum of

dollars ($).

Item 201.—For the supervisory system, complete, including a concrete floor in the New York administration building, the lump sum of

dollars ($).

Item 202.—For four (4) carbon monoxide recorders, complete, the lump sum of

dollars ($).

Item 203.—For miscellaneous equipment, the lump sum of

dollars ($).

Item 206.—For installing air blast power transformers and 13,200 volt and 2,300 volt oil switches furnished under another contract, the lump sum of

dollars ($).

Item 207.—For furnishing and installing 440 volt oil switches and potential and current transformers and for installing current transformers furnished under another contract, the lump sum of

dollars ($).

Work not susceptible of classification.

Item 300.—For any work or materials which shall be required to be done or furnished in or about the Works which it is elsewhere in this contract expressly provided shall be paid for under this Item, or

For any work or materials which shall be required to be done or furnished in or about or for the more perfect performance of the Works which are not mentioned, specified, or indicated, or otherwise provided for in this contract and which, in the opinion of the Engineer, are not susceptible of classification under the foregoing Items of the Schedule:

Work to be performed at net cost and in addition 15%.

The Contractor shall, if ordered in writing, do and perform such work and furnish such materials at and for the actual necessary net cost in money to the Contractor for labor, for insurance upon such labor under the Workmen's Compensation Law, and for materials incorporated in the work, and in addition thereto fifteen per centum (15%) of such net cost.

No claim in excess.

The Contractor shall have no claim in excess of the above, such payment being in full compensation for the performance of such work and the furnishing of such materials and for all expense in connection therewith or incidental thereto as aforesaid, including the expense of plant, power, tools, supplies and other means of construction, administration, superintendence and insurance, and for all the loss, damage, risks and expenses hereinbefore mentioned in the first paragraph of this Article.

Insurance upon labor.

The amount of the insurance upon labor under the Workmen's Compensation Law shall be determined by the amount of wages actually and necessarily paid for such labor and the rate of insurance for such labor paid

by the Contractor either in the New York State Insurance Fund, or in any stock corporation or mutual association authorized to transact the business of workmen's compensation insurance in the State of New York or the State of New Jersey as may be required by law in either or both States, as the case may be. If the Contractor shall not have insured either in such New York State Insurance Fund or in any such stock corporation or mutual association, the rate allowed will be the rate which he would have been required to pay for such insurance in the New York State Insurance Fund had he insured therein or at the rate determined by the Compensation Rating and Inspection Board of New Jersey, as the case may be.

Daily reports required.

If any work or materials shall be required to be done or furnished under this Item, for cost plus fifteen per centum (15%), the Contractor shall, at the end of each day, furnish to the Engineer daily time slips showing the name and number of each workman employed on such work, the number of hours employed thereon, the character of work done and the wages paid or to be paid to him, the rate and amount of workmen's compensation insurance and also a daily memorandum of such materials furnished, showing the amount and character of such materials, from whom purchased and the amount paid or to be paid therefor. If required by the Commissions or the Engineer, the Contractor shall produce any books, vouchers, records and memoranda showing the labor and materials actually paid for and the actual prices therefor. Such daily time slips and memoranda shall not, however, be binding upon the States, and if any question or dispute shall arise as to the correct cost of such labor or materials, the determination of the Engineer upon such question or dispute shall be final and conclusive.

Prices may be fixed by agreement.

Instead of the method above described for paying for any such work or materials under this Item, the Engineer may, but only with the approval of the Commissions,

agree with the Contractor upon reasonable unit prices or a reasonable lump sum price for such work and materials. Such additional unit prices or such lump sum price shall be included under this Item as a supplemental schedule.

QUANTITIES.

Commissions may change quantities.

ARTICLE XVII.—The Commissions reserve the right to make additions to, or deductions from, the work as called for on the drawings or in the specifications and as comprised in the various items for which the Contractor is to quote lump sum prices in his proposal. Such changes in the work, if any, will be of a nature that shall not materially affect the substance but more perfectly effect the performance of the work.

No claims because of changed quantities.

The Contractor shall not make nor have any claim for damages or for anticipated profit or for loss of profit or otherwise because of such additions to, or deductions from, the work comprised in the various items.

Value of reductions in work.

Should any deductions be made from the work indicated on the drawings or in the specifications, the reasonable value of the work covered by such deductions shall be determined by the Engineer.

Commissions may amplify drawings.

ARTICLE XVIII.—The Commissions shall have the right during the progress of the work to amplify the drawings, to add explanatory specifications and to furnish additional drawings.

Contractor bound to complete in best manner.

ARTICLE XX.—The Contractor shall complete all work in accordance with the plans and specifications and according to the other provisions of this contract and within the time specified in this contract in the most workmanlike manner and with the highest regard for the safety of life and property and according to the directions given by the Engineer.

The specifications and drawings call for equipment intended to produce specified results and for definite pieces of equipment the general purpose of which is indicated.

Contractor responsible for correct functioning of equipment.

The prices to be included in this proposal shall be based upon furnishing the equipment as it is shown on the drawings and described in the specifications.

Before the Contractor begins to manufacture any of the equipment to be furnished under this contract, the Engineer will furnish the Contractor with wiring diagrams showing the proposed manner of connecting the equipment.

The Contractor shall carefully check the wiring diagrams and shall call to the attention of the Engineer any errors or omissions therein which would cause the equipment called for to fail to function in accordance with the requirements of the specifications.

The failure on the part of the Contractor to call to the attention of the Engineer any errors in the manner of connection or in the type or quantity of equipment specified will make him responsible for the correct functioning of the equipment as a whole and in the event of the failure of the equipment to function as required, the Contractor shall change the wiring or substitute other and suitable equipment without additional expense to the Commissions.

Beginning from the time the work of installation is begun, the Contractor will also be held responsible for, and shall make good any loss or damage to the power transformers and oil switches and their appurtenances to be furnished under another contract and to be installed under this contract.

Responsibility for equipment delivered under another contract.

ARTICLE XXI.—All labor, materials, plant, tools, appliances, equipment and supplies necessary to complete all work covered by the specifications and provisions of this contract, shall be furnished by the Contractor and shall be of the best character, each of its kind.

Best labor, etc., to be furnished.

INSPECTION.

Inspection.

ARTICLE XXII.--The Commissions contemplate, and the Contractor approves, the most thorough and minute inspection at all times by the Commissions and their Engineer and by their representatives or subordinates of all work to be done and of all materials to be furnished under this contract and of the manufacture or preparation of such materials. It is the intention of the Commissions that their Engineer shall draw the attention of the Contractor to all defects in workmanship or materials or other errors or variations from the requirements of this contract. No omission, however, on the part of the Commissions or their Engineer or any of their representatives or subordinates to discover or point out such errors, variations or defects, shall give the Contractor any right or claim against the States or shall in any way relieve the Contractor from his obligations according to the terms of this contract.

Contractor to afford facilities for inspection.

ARTICLE XXIII.—The Contractor shall at all times give to the Commissions and their members, to the Engineer and his assistants and to any person designated by the Commissions all facilities, whether necessary or convenient, for inspecting the work to be done and materials to be furnished under this contract. The Contractor shall furnish without additional expense specimens and certified copies of physical and chemical tests of all materials furnished, as required by the Engineer. The members of the Commissions, the Engineer and his assistants and all persons bearing the authorization of the Commissions shall be admitted at any time summarily and without delay to any part of the Works or to inspection of materials at any place.

Uncovering finished work.

ARTICLE XXIV.—The Commissions or their Engineer shall be furnished by the Contractor with every reasonable facility for ascertaining whether the work is in accordance with the requirements and intention of this contract, even to the extent of uncovering portions of fin-

ished work. Should the work thus exposed or examined prove satisfactory, the uncovering and the replacing or the making good of the parts removed shall be paid for at the contract prices for the class of work done; but should the work exposed or examined prove unsatisfactory, such uncovering, replacing and making good shall be at the expense of the Contractor.

Inspection not to relieve Contractor.

ARTICLE XXV.—The inspection of the work shall not relieve the Contractor of any of his obligations to fulfill this contract as herein prescribed. Defective work shall be made good and unsuitable materials will be rejected even though such work and materials may have been previously accepted or estimated for payment. If the work or any part thereof shall be found defective before the final completion and acceptance of the Works, the Contractor shall forthwith make good such defects in a manner satisfactory to the Engineer. If any material selected or brought upon the ground for use in the work shall be condemned by the Engineer as unsuitable or not in conformity with the plans and specifications, the Contractor shall forthwith remove such materials.

Defects in equipment to be remedied.

If the Commissions shall determine at any time within a period of one (1) year after the final completion of this contract that there are any defects in the equipment to be furnished under this contract, or its appurtenances or the installation work to be performed under this contract, the Contractor shall, upon notice in writing from the Commissions, forthwith remedy such defects without additional cost to the Commissions.

Acceptance not to relieve Contractor.

ARTICLE XXVI.—Acceptance of any part of the electrical equipment or of materials therefor shall not relieve the Contractor of his obligation to furnish sound material and perform sound work, whether with respect to such part or to any other part of the electrical equipment.

Engineer's determination.

ARTICLE XXVII.—To prevent disputes and litigations the Engineer shall, in all cases, determine the classification for payment and the amount, quality, acceptability

and fitness of the several kinds of work and materials which are to be performed or furnished under this contract. He shall determine every question in relation to the Works and the performance thereof and every question which may arise relative to the fulfillment of this contract on the part of the Contractor. His determination and estimate shall be final and conclusive upon the Contractor, and if any question touching this contract shall arise between the parties hereto, such determination and estimate shall be a condition precedent to the right of the Contractor to receive any payment under this contract.

FACILITIES FOR OTHER CONTRACTORS.

Engineer's explanation.

ARTICLE XXVIII.—The Engineer shall make all necessary explanations as to the meaning and intention of the specifications. He shall give all orders and directions contemplated therein or thereby and in every case in which a difficult or unforeseen condition shall arise in the performance of the work required by this contract.

Contractor to obey directions of Engineer.

The Contractor shall promptly obey and follow every direction which shall be given by the Engineer, including any direction which the Engineer shall give by way of withdrawal, modification or reversal of any previous direction given by him.

Relation to other contractors.

During the progress of the work under this contract it will be necessary for other contractors and persons authorized by the States to do work in or about the Holland Tunnel, including but not limited to constructing the plazas, administration buildings and ventilation buildings, paving the tunnel roadway, installing pumping equipment, installing power cables and applying certain finish to the tunnels. The Commissions reserve the right to put such other contractors and persons to work and to afford them access to their work across the site of the work to be performed hereunder at such time and in such manner as the Commissions may in their discretion deem proper.

Prosecution of work in relation to other contractors.

The Contractor shall prosecute his work continuously and diligently and shall keep his work so advanced that the Commissions will be enabled to proceed with the above mentioned work, and any other work to be performed under other contracts. The Contractor shall so conduct his work as not to impede or interfere with the work of such other contractors or persons and shall so arrange his work that such other contractors and persons may expeditiously complete their work in order that the Holland Tunnel may be put in operation at the earliest possible date and for that purpose the Contractor herein shall afford to such other contractors or persons such facilities as the Commissions may require.

Engineer to decide disputes.

Wherever any work performed or to be performed by the Contractor under this contract shall affect any work performed or to be performed by any other contractor or persons, the Engineer shall decide any question or dispute between the Contractor and such other contractor or persons and the manner, time and method in which they shall perform their respective work and the facilities which each shall afford to the other or others, and his determination shall as aforesaid be final and conclusive upon the Contractor.

DRAWINGS.

Specifications and drawings explanatory of each other.

ARTICLE XXIX.—The specifications do not include all requirements, but are requirements in addition to those elsewhere given or provided in this contract. The specifications and the other provisions of this contract and the contract drawings are intended to be explanatory of one another. Should, however, any discrepancy appear or any misunderstanding arise as to the import of anything contained in either, the explanation or decision of the Engineer shall be final and conclusive. In all drawings, dimensions expressed by figures are to be used instead of scaled dimensions.

Contract drawings.

ARTICLE XXX.—The contract drawings referred to in this contract and in the specifications bear the general title:

NEW YORK STATE
BRIDGE AND TUNNEL COMMISSION

AND

NEW JERSEY INTERSTATE
BRIDGE AND TUNNEL COMMISSION

THE HOLLAND TUNNEL

CONTRACT NO. 19

CONTRACT DRAWING NO. ....

These drawings are numbered 1 to 28, dated May 18, 1926, and countersigned by the Chief Engineer.

Other drawings.

ARTICLE XXXI.—In addition to the contract drawings already mentioned, the Commissions have on file or are preparing drawings of the plazas, tunnels, administration buildings, ventilation buildings and shaft interiors which have been or are to be constructed under other contracts and in which a portion of the electrical equipment to be furnished under this contract is to be installed. The Contractor shall examine these drawings, which may be seen in the office of the Engineer, and familiarize himself with the conditions to be met in installing the equipment. These drawings show the location of the conduits in which the wires and cables are to be installed, the positions in which the air blast power transformers and 13,200 and 2,300 volt oil switches to be installed under this contract are to be located and where the various control and supervisory boards are to be located in the different buildings.

Construction drawings.

During the course of the work, construction drawings will be issued from time to time. These construction drawings will show the lengths of the various conduit runs. The Contractor shall check the lengths of such

runs before pulling wire or cables and he shall have no claim because of errors in such lengths as given on the drawings, other than an adjustment based on any excess or deficiency in the quantities of wire or cable which he actually places compared to the quantities as shown in wiring schedules or on the drawings.

Contractor has examined location, drawings, etc.

ARTICLE XXXIII.—The Contractor hereby represents that prior to the execution of this contract, he has examined in detail on the ground the location of the work mentioned herein and indicated on the contract drawings and that he has fully examined the contract drawings and the other drawings referred to in Article XXXI, and has read each and every clause and section of this contract and of the specifications and has had full opportunity to consider the same and make necessary investigations relating thereto; and he shall not make any claim for or have any right to damages or an extension of time for completion of the Works or any other concession because of any misinterpretation or misunderstanding of this contract or of the specifications or of the drawings or because of any lack of information.

CHAPTER IV.

SPECIFICATIONS.

1. The general clauses of the specifications are grouped under different subdivisions and the requirements as to specific kinds of work under different items.

BRIEF DESCRIPTION OF THE WORK.

Scope of the work.

2. The work to be done under this contract consists of furnishing and installing the lighting systems in the tunnels, open cut approaches, ventilation buildings, shafts, New York entrance plaza, and the New Jersey entrance and exit plazas including switches, transformers, wiring, receptacles, fixtures, bulbs and panel boards; furnishing and installing a complete control system for the ventila-

tion equipment including control boards and the necessary control and power wiring; furnishing and installing a complete telephone system, a carbon monoxide recording system and a complete supervisory system including traffic signals; furnishing and installing equipment for charging electric truck storage batteries, furnishing miscellaneous testing equipment, installing power transformers and oil switches furnished under another contract, drying out all transformers before they are placed in service and placing a small amount of concrete in the control and supervisory room floors.

Location of tunnels.

3-1. The Holland Tunnel consists of two tunnels. The north, or westbound tunnel, extends from the north side of Broome Street between Hudson and Varick Streets, Borough of Manhattan, New York City, to the east side of Provost Street at Fourteenth Street, Jersey City, New Jersey. The south, or eastbound tunnel, extends from the east side of Provost Street at Twelfth Street, Jersey City, New Jersey, to the west side of Varick Street at Canal Street, Borough of Manhattan, New York City.

Location of plazas.

3-2. The entrance and exit plazas will be situated immediately adjacent to the ends of the two tunnels as described above. Their extent and relation to the tunnels are shown on the contract drawings.

Location of ventilation buildings.

3-3. The ventilation buildings will be located as follows:

The land ventilation building, New York, on the west side of Washington Street between Canal and Spring Streets, New York City.

The river ventilation building, New York, just east of the New York pierhead line between Pier New 34, North River and Pier New 35, North River, as they now exist.

The river ventilation building, New Jersey, just west of the New Jersey pierhead line on the site of the new Erie Railroad pier now under construction.

The land ventilation building, New Jersey, in the Erie Railroad yard, just west of the New Jersey bulkhead and south of the center line of Twelfth Street, produced, Jersey City.

Location of administration buildings.

3-4. The administration building, New York, will be located on the west side of Varick Street between Canal and Vestry Streets, New York City.

The administration building, New Jersey, will be located on the southeast corner of Fourteenth and Provost Streets, Jersey City.

Other contractors.

5. The attention of the Contractor is directed to the necessity of so prosecuting the work as to cause a minimum of interference with other contractors or persons doing work in the Tunnel at the same time. It is anticipated that this work will consist of, but not be limited to, constructing the plazas, ventilation buildings and administration buildings, placing tunnel finish, paving the tunnel roadway, installing power cables, ventilating, pumping and other equipment and placing frames for niche doors in the sidewalls of the tunnel.

Defects in equipment to be remedied.

The attention of the Contractor is further directed to the requirement of the contract that all equipment must be guaranteed and that all defects developing in the equipment to be furnished under this contract, or its appurtenances or the installation work to be performed under this contract, due to faulty material, workmanship or installation, within a period of one (1) year after the final completion of this contract, shall be remedied by the Contractor without additional cost to the Commissions, and that a bond must be furnished, as stipulated hereinafter to cover such guarantee.

GENERAL CLAUSES.

SUBDIVISION 1—METHOD OF PROSECUTING THE WORK.

Manner of prosecution.

6. All the work shall be prosecuted in the manner, according to conditions, best calculated to promote rapidity in construction and installation, to secure safety to life

and property, to reduce to a minimum any interference with other contractors or persons engaged in working in the tunnel, and to insure the completion of the work within the contract time.

Work to be diligent in all parts.

9. The Contractor shall conduct his operations diligently in all parts of the work, co-ordinating the different parts so that the completion of each part as well as the entire work shall not be unnecessarily delayed and so that there shall be no interference, delay or danger to other contractors or persons engaged in the Holland Tunnel project. Work is to be commenced and maintained under the orders and directions and to the full satisfaction of the Commissions or their Engineer.

Work to be completed within time limit.

10. The electrical equipment to be furnished and installed under this contract forms a part of the Holland Tunnel, which the interests of the States imperatively require shall be completed and put in operation without delay. The Contractor shall prosecute his work in such manner as to make it reasonably probable, in the judgment of the Engineer, that the work will be completed within the time limited therefor.

Progress schedule.

In order to insure the completion of the work within the time required by the contract the various items shall be completed on or before the dates listed below:

Tunnel lighting	November 1, 1926;
Plaza lighting	November 1, 1926;
Telephone equipment	November 1, 1926;
Lighting of buildings	December 1, 1926;
Installation of air blast transformers and oil switches in land bldg., N. Y.	December 1, 1926;
Power and control wiring	As directed;
Control board	January 1, 1927;
Supervisory system	February 15, 1927;
CO recorders	February 15, 1927;
440 volt oil switches	February 1, 1927;
Miscellaneous equipment	As directed.

Engineer may order working shifts increased.

The Contractor, if directed by the Engineer, shall rearrange the work and increase the number of shifts and the number of men in each shift to the extent that may be necessary to insure the completion of the work within the time required by this contract; but the failure of the Engineer to issue such directions shall not relieve the Contractor of his responsibility for the completion of the work within the time limited therefor.

Contractor's equipment.

11. The Contractor shall furnish equipment and other means of construction adequate for the prosecution of the work at a rate of progress which, in the judgment of the Engineer, will secure the completion of the work within the time herein limited therefor. If at any time the equipment or any portion of it shall appear to the Engineer to be or likely to become inadequate, incomplete or faulty, the Contractor shall promptly obey the orders of the Engineer to supplement or to remove and replace the same; but the failure of the Engineer to issue such orders shall not relieve the Contractor of his responsibility for the adequacy and safe operation of the equipment.

Order to begin work.

12. No work shall be begun until the Commissions shall issue to the Contractor an order directing him to proceed. The order shall be in such form and shall cover such portions of the work as the Commissions shall prescribe.

Notice of intention to commence work.

13. The Contractor, at least one (1) week before commencing work at any point, shall give notice in writing to the Commissions of his intentions to commence such work. The Contractor shall also, at least two (2) weeks before commencing or resuming manufacture of any article called for by these specifications, give notice in writing to the Engineer of his intention to commence or resume such manufacture, with the name and address of the manufacturer and the amount and description of the material to be manufactured.

Shop tests.

Before any equipment is shipped from the factory, it shall be fully tested. It shall comply with the requirements of the Standards of the Power Club and of the American Institute of Electrical Engineers. In case any requirements of the two standards conflict, those of the Power Club shall govern. The Contractor shall furnish all necessary labor, instruments, power and material and shall conduct the tests under the supervision of the Engineer. Complete copies of all test records shall be furnished to the Commissions. However, these tests, if satisfactory, are not to be construed as an acceptance of the equipment.

Installation tests.

After installation, the Contractor shall make, under the supervision of the Engineer, all tests hereinafter specified and shall furnish all necessary instruments, labor and material. Power for these tests will be furnished by the Commissions.

Cable after installation shall be tested at eighty per centum (80%) of the voltage specified for factory tests.

Installation tests shall include the adjustment of all relays and shall demonstrate to the satisfaction of the Engineer that all equipment functions in accordance with the requirements of the specifications.

Equipment to be approved.

14. The equipment the Contractor proposes to use for the installation of the electric equipment must receive the Engineer's approval before it is placed in operation, but such approval shall not relieve the Contractor of responsibility for injury to persons or damage to property, or for the adequacy and safe operation of the equipment.

Orders to superintendent, overseer or foreman.

18. Orders and directions may be given orally by the Engineer to, and shall be received and promptly obeyed by the Contractor or his representative or any superintendent, overseer or foreman of the Contractor who may have charge of the particular work in relation to which the orders or directions are given, and a confirmation in writing of such orders or directions will be given to the

Contractor by the Engineer if so requested. The Contractor or his duly authorized representative shall be present at all times on the work to receive orders and directions from the Engineer. The Contractor shall also maintain, during the performance of the work, an office in New York City or Jersey City in the vicinity of the work, at which he or his duly authorized representative shall be present at all times. Orders or directions, written or oral, from the Engineer delivered at said office shall be considered as delivered to the Contractor. Copies of the contract, including the specifications, and of the drawings for the work shall be kept at said office ready for use at any time.

Waste material.

19. The Contractor must not allow waste material of any kind to remain on the streets or to accumulate on the work, but he must cart away all such material and dispose of it as hereinafter provided at his own expense. The Contractor shall also keep the work, streets and all public places occupied by him clear of all refuse and rubbish and leave them in a neat condition.

Sanitary conveniences.

21. Sanitary conveniences, of a form approved by the Engineer shall be constructed and maintained by the Contractor for the use of his employees.

Surface obstructions to be guarded.

22. Surface obstructions shall be guarded and shall be indicated at night by suitable and sufficient lights.

Advertisements not permitted.

The Contractor shall not place or permit the placing of any advertising matter, other than the name and address of the Contractor, upon fences, buildings or any part of the work or plant or materials.

Competent men.

23. The Contractor shall employ competent, skillful and faithful men to do the work, and for special work requiring skill along any particular line, men especially skilled in such line shall be employed. Whenever the Engineer shall notify the Contractor in writing that in his opinion any man on the work is incompetent, unfaithful or disorderly, such man shall be discharged from the work and shall not be employed on it again.

Electric lighting and power.

24. The current for light and power is conducted through the tunnel by means of a temporary line. This line will be available to the Contractor for purposes of illumination and for such power as he may require in performing the work covered under this contract. Special illumination shall be provided by the Contractor wherever work is in progress, or is to be inspected.

All electric wires must be kept thoroughly insulated and special precautions taken to avoid short circuits. The power and lighting circuit in the tunnel shall be maintained by the Contractor. Any damage to power and lighting circuits caused by the Contractor shall be made good at his expense.

The current for the lighting and power supplied to the Contractor by the Commissions shall be paid for by the Contractor at the rate paid by the Commissions to the power companies and these charges will be based upon the number of lights and the power equipment he may employ from time to time.

Temporary line to become the Contractor's property.

Upon the completion of the installation of the permanent tunnel lighting system, the temporary lighting system including all wires, lamps, fixtures and fastenings will become the property of the Contractor and shall be removed by him. He shall allow the Commissions credit for the value of the material salvaged.

Facilities for Engineer.

28. The Contractor shall give to the Engineer all necessary facilities for making measurements.

Payment.

29. Payment for compliance with the requirements of this Subdivision, including the credit allowed for the temporary lighting system, is deemed to be included in the prices stipulated in the Schedule.

SUBDIVISION 2—MAINTENANCE OF TRAFFIC.

Storage of materials in Tunnel.

37. The storage of materials in the Tunnel shall be to the extent permitted by the Engineer, as necessary for the conduct of the work. Such storage shall not obstruct

the roadway or sidewalk so as to prevent free passage or repassage of other contractors or persons engaged in constructing or equipping the Tunnel.

Occupation of streets.

38. The Contractor will be permitted to occupy the streets as approved by the Engineer provided that such occupation shall be regulated so as to cause the least practical interference with travel or with the use of adjacent property.

Access to fire hydrants.

39. The Contractor shall not interfere with free access to any fire hydrant or fire alarm box, and shall place no materials within ten (10) feet of the same at any time.

Payment.

42. Payment for compliance with the requirements of this Subdivision is deemed to be included in the prices stipulated in the Schedule.

SUBDIVISION 7—MATERIALS AND WORKMANSHIP.

Best materials and workmanship.

107. All materials and workmanship shall be of the best class in every respect, and the Engineer shall be the sole judge of their quality and adequacy.

Imperfect material to be replaced.

108. Any imperfect material which may be discovered before the final completion and acceptance of the Works shall be replaced immediately upon the requirement of the Engineer and at the Contractor's expense, notwithstanding that it may have been accepted previously or estimated for payment.

Damaged work to be replaced.

109. Any work which may become damaged from any cause before the final completion and acceptance of the Works shall be replaced by good and sound material at the Contractor's expense.

Condemned materials to be removed.

110. If any material shall be condemned by the Engineer as unsuitable or not in conformity with the specifications, the Contractor shall forthwith remove such material from the site of the work.

Payment.

111. Payment for compliance with the requirements of this Subdivision is deemed to be included in the prices stipulated in the Schedule.

SUBDIVISION 8—CLEANING UP.

Cleaning up.

116. Any portion of the Tunnel, in which the work under this contract has been completed, shall be cleared of all of the Contractor's equipment and materials. Before final payment is made all parts of the Works shall be cleaned up and put in a condition acceptable to the Engineer.

Payment for cleaning up.

117. Payment for cleaning up is deemed to be included in the prices stipulated in the Schedule.

ITEMS.

ITEM 27—CONCRETE AND GROUT.

Composition.

27-1. Concrete shall consist of a mixture of approved Portland cement, fine aggregate, coarse aggregate, and clean, fresh water.

Fine aggregate.

27-2. Fine aggregate shall consist of sand having clean, hard, strong, durable, uncoated grains, free from soft or flaky particles, loam, alkali, organic matter or other deleterious substances.

Coarse aggregate.

27-3. Coarse aggregate for concrete shall consist of sound, hard, strong, clean gravel.

Proportions.

27-5. Concrete shall in general be proportioned of one (1) part of cement, two (2) parts of fine aggregate, and four (4) parts of coarse aggregate.

Grout.

Grout for grouting relay boxes, switchboard cases or other fixtures in place shall be composed of one (1) part of Portland cement and two (2) parts of fine aggregate, to which sufficient clean fresh water has been added to make a mixture of the proper consistency to flow freely and fill all voids between the fixtures and the wall.

Finishing floors.

27-6. In the main control rooms, the supervisory control rooms and the 220 volt control rooms in the ventilation buildings, and in the supervisory control room in the New York administration building, after the angle or channel sills have been set in position, about three (3)

inches of concrete shall be placed on the floors with a top coat of mortar of sufficient thickness to enable a smooth sidewalk finish to be obtained. In these rooms he shall also provide concrete partitions in the trenches below the cabinets and shall increase the thickness of the concrete floor in some of the compartments so formed. The mortar shall be composed of one (1) part of Portland cement and two (2) parts of fine aggregate.

Surface finish

27-7. The mortar floor surface shall be given an approved treatment to harden it and to prevent dusting.

Forms.

27-15. Suitable, clean, tight forms, substantially braced, shall be provided by the Contractor, where required, to support the concrete until it is set.

Payment, concrete and grout.

27-27. No separate payment will be made for concrete or grout used in fastening fixtures in place or for concrete or mortar used in finishing floors or for conduit and cable trenches, but payment therefor is deemed to be included in the lump sum prices stipulated in the schedule.

ITEM 70—STEEL.

Requirements.

70-1. Steel shapes, plates and rods shall be made of open hearth steel conforming to the requirements of the Standard Specifications of the American Society for Testing Materials for Structural Steel for Buildings, Serial Designation: A 9-24.

Dimensions, etc.

70-2. They shall be of the dimensions and shapes and be placed in the locations shown on the drawings.

Steel cabinets.

70-3. Steel cabinets and panels made up of sheets and shapes, as specified in detail under the various items, shall be furnished and installed in the locations shown on the drawings. These cabinets will house relays, telephone cable terminals and other apparatus described more fully hereinafter and will serve as switchboards, carrying upon their walls and doors, meters, control switches and indicating lights.

Keys.

70-4. Wherever locks are called for in the detailed specifications for cabinets, steel enclosures or panel box covers, the keys shall be furnished by the Contractor and turned over to the Engineer, suitably tagged. All such keys shall be subject to master keys as directed.

Partitions, doors, etc.

70-5. The Contractor shall furnish and install in the 220 and 440 volt control rooms in each of the ventilation buildings, the steel partitions at the ends of the 220 volt boards, with the floor inserts and doors as specified under Item 200.

Flooring supports.

70-6. In the ventilation buildings, he shall furnish and install the steel work to support the insulating, fireproof flooring adjacent to the cabinets as specified under Items 200 and 201.

Steel mesh enclosures.

70-7. Around the contactor boards in the 220 and 440 volt control rooms in each of the ventilation buildings, in the location shown on the drawings, the Contractor shall furnish and erect an enclosure consisting of a framework of angles and channels covered with a steel mesh built up of ribbon steel similar to the sample on view in the Engineer's office. The posts supporting the mesh shall be suitably anchored to the floor by means of approved inserts or expansion bolts. Each enclosure shall be provided with five gates, each equipped with an approved latch and rim lock, providing access to the front of the board and to the space in back of it.

Sills and anchors.

70-8. The Contractor shall furnish and install angle or channel sills in the concrete floor, for mounting the cabinets, also the necessary anchor and holding down bolts, where shown on the drawings or specified hereinafter.

Cover plates.

70-9. He shall furnish and install the steel plates covering the niches which house the lighting distribution panels in the ventilation buildings, also the plates covering the three panel boards in each of the ventilation buildings and the two panel boards in the New York administration building, for distributing the D. C. control current.

70-10. In the fire extinguisher niches, angle brackets and gratings for supporting the fire extinguishers shall be furnished and installed as shown on the drawings. Fire extinguisher niches.

70-11. All steel entering into the construction of cabinets, housings, switch trucks, enclosures and other portions of the equipment to be furnished under this contract, except the steel buried in the floor for mounting and anchoring equipment, shall be suitably painted with at least two coats of approved rust-inhibitive paint or enamel as directed. Steel to be painted.

All materials entering into the manufacture of paints or enamels used on steel shall conform to the requirements for pigments and vehicles of the American Society for Testing Materials. Requirements, paint.

70-12. No separate payment will be made for steel entering into the construction of the equipment to be furnished under this contract, but payment therefor is deemed to be included in the lump sum prices stipulated in the Schedule. Payment, steel.

ITEM 85—GALVANIZED STEEL ELECTRIC CONDUITS.

85-1. The term "galvanized" means coating the surface of the iron or steel with zinc by processes generally known as the hot dip process or the electro-galvanizing process. The galvanizing baths shall contain pure zinc only without the mixture of any other metal. Metal to be galvanized shall, after being thoroughly cleaned, pickled and dried, be evenly and heavily coated with zinc, which shall be free from buckles, blisters, pinholes, ragged edges or other defects. Galvanizing shall not be done until the articles to be galvanized have been completely fabricated. Samples of galvanizing shall successfully withstand four consecutive immersions of one minute each in a solution of copper sulphate crystals having a specific gravity of 1.186 plus or minus 0.003 at 65° F. (18° C.). This test shall be conducted by the methods outlined for the Preece Test under Serial Designation A 90-24 of the American Society for Testing Materials. Physical requirements.

Galvanized steel electric conduits.

85-3. The conduits for electric wires, unless otherwise specified, shall be of rigid type, made of soft weldable steel rolled from solid ingots, galvanized inside and outside. The inside shall be further protected by a coat of approved enamel. The material shall comply with the requirements of the Underwriters' Laboratories of the National Board of Fire Underwriters (Nov. 1917 Edition). The conduits shall be placed in the locations and manner shown on the drawings. The installation shall comply with the requirements of an electrical installation of the highest grade.

Quality.

85-4. Electric conduits shall be delivered on the work in bundles of standard length pipe, each length marked with the trade mark of the manufacturer. They shall bend cold ninety degrees (90°) about a radius equal to ten (10) diameters without flaw or fracture. Samples of conduits shall be submitted for approval before they are purchased for the work.

Cleaning.

85-5. All conduits shall be carefully cleaned both before and after placing, all ends shall be reamed free from burrs and inside surfaces shall be free from all imperfections which might injure the cable.

Joints.

85-7. All joints shall be made with standard couplings (galvanized) and well treated with red lead. All threads cut on conduit while being placed shall be given a coat of rust-inhibitive zinc paint. All free ends shall be threaded and capped, and all connections shall be watertight.

Bends and offsets.

85-8. Bends and offsets may be made on the work if proper tools are used, but in no case shall deformed, split or crushed conduits be used. All bends shall be of as large a radius as possible.

Payment, galvanized steel conduits.

85-12. No separate payment will be made for galvanized steel and electric conduits but payment therefor is deemed to be included in the lump sum prices stipulated in the Schedule.

ITEM 90—CAST IRON.

Chemical properties.

90-1. Cast iron shall be tough gray iron made from iron remelted in a cupola or air furnace and shall contain not more than twelve-hundredths of one per centum (0.12%) of sulphur. First-class machinery scrap approved by the Engineer to the amount of thirty per centum (30%) of the total melt may be used, but no mill cinder, white or burnt iron, or any other scrap iron will be permitted in the composition.

Soundness and finish.

90-3. Castings shall be made with a sinking-head sufficiently high to insure sound metal throughout. They must have clean, smooth surfaces and must be free from blow holes, cold shuts, flaws, fins and surface imperfections. Castings having blow holes plugged will be rejected. Castings shall be straight and free from wind and shall conform accurately to the form and dimensions shown on the drawings. All castings shall be neatly chiseled, and wire-brushed, dressed, sand blasted or cleaned by other approved methods and machined as required.

Payment, cast iron.

90-4. No separate payment will be made for cast iron but payment therefor is deemed to be included in the lump sum prices stipulated in the Schedule.

ITEM 112—ASBESTOS LUMBER.

Composition.

112-1. Asbestos lumber, as shown on the drawings, or as ordered by the Engineer, shall be made of fibered asbestos, free from organic matter, impregnated with Portland cement and compressed into homogeneous sound, dense sheets of uniform thickness throughout and shall have at least one smooth sand finished surface.

Test pieces.

112-2. Test pieces of asbestos lumber of the thickness specified, in such quantity and size as may be directed, shall be furnished free of charge by the Contractor for tests.

Tests.

112-3. All asbestos lumber furnished under this contract shall possess the following qualities as determined by test:

Weight.

(a) When dried in an oven for twelve (12) hours at a temperature of two hundred twenty degrees (220°) F., the one (1) inch thick material shall weigh not less than nine and six-tenths (9.6) pounds per square foot.

Absorption.

(b) After being dried in the manner prescribed in the preceding paragraph, the test piece shall be immersed in water at room temperature. The water shall then be raised to the boiling point, after which it shall be allowed to cool for twenty-four (24) hours. The test piece shall then be removed and weighed. The increase in weight after immersion shall not exceed twenty per centum (20%).

Breaking strength, dry.

(c) A test piece twelve (12) inches wide and of sufficient length to get proper bearing on supports separated by a distance of twelve (12) inches, shall, after drying as prescribed in paragraph (a) above, be capable of sustaining without rupture the load indicated in the following table when applied to a cylindrical bar placed on the test piece midway between supports.

Thickness, inches	Weight dry, lbs. per sq. ft.	Load, lbs.
1	9.6	1200

Breaking strength, wet.

(d) Test pieces treated as prescribed for absorption shall, when wet, support, without rupture, loads within thirty-three and one-third per centum (33 1/3%) of that prescribed in the paragraph next preceding, and after drying as prescribed in paragraph (a) above, shall regain full strength shown prior to immersion.

Heat test.

(e) Test pieces heated with an electric muffler to a temperature of fifteen hundred degrees (1500°) F. shall, when cool, show no signs of disintegration, splitting or cracking other than fine surface hair cracks.

112-4. No separate payment will be made for asbestos lumber, but payment therefor is deemed to be included in the lump sum prices stipulated in the Schedule.

Payment, asbestos lumber.

ITEM 193—WIRE AND CABLES.

193-1. Solid conductors and wires making up stranded conductors shall be of soft copper having, before stranding, the physical (not electrical) characteristics prescribed by the specifications of the American Society of Testing Materials entitled "Standard Specifications for Soft or Annealed Copper Wire," Serial Designation: B 3-15.

Physical characteristics.

193-2. The number of wires in a conductor shall conform to the standardization rules of the American Institute of Electrical Engineers for the size of conductor specified.

Number of wires.

193-3. The resistance of any portion of any conductor shall be not more than two per centum (2%) greater than that prescribed by the standardization rules of the A. I. E. E. for a conductor of standard annealed copper of the specified size and kind. In multiple conductor cables an additional allowance shall be made for the lay of the conductors in the cable.

Resistance.

193-4. The average area of cross section of the conductor or conductors shall not be less than the nominal area of the wires specified. The minimum area of cross section of the conductor or conductors at any part of the cable shall not be less than ninety-eight per centum (98%) of the nominal area of the wires specified. The area in each case shall be determined by the method prescribed by the standardization rules of the A. I. E. E.

Cross sectional area.

Wires shall be uniform in section free from flaws, scales and other imperfections.

193-5. Lead sheath, where called for, shall be commercially pure lead or an alloy of lead and antimony or lead and tin as approved by the Engineer.

Lead sheath.

VARNISHED CAMBRIC INSULATED CABLE.

Construction of cable.

193-6. The cable covered by these specifications shall be made up of the required number of conductors each separately covered with insulating material of the prescribed thickness and then assembled with a suitable lay with the interstices filled and rounded out with paper or jute laterals or fillers. The whole shall be wrapped with an outer belt of insulating material of the required thickness.

Insulation, general.

193-7. The insulating material shall consist of a number of layers of cambric cloth treated before application with an electric, mineral base varnish. The varnished cloth shall not exceed thirteen and five tenths (13.5) mils in thickness and shall have not less than fifty-five (55) by sixty (60) picks per inch. It shall be substantially free from wrinkles, blisters and all other imperfections and shall be pliable and not crack when doubled upon itself. The dielectric strength of the individual layers shall not be less than 800 volts per mil at 25° C., and shall average 600 volts per mil on ten (10) samples tested at 75° C. The tensile strength shall not be less than twenty-five hundred (2,500) pounds per square inch. The varnish film shall not be soft or tacky after being immersed in the filler compound at a temperature of 150° C. for fifteen (15) minutes and subsequently cooled to room temperature after removal.

The thickness of the conductor and belt shall be determined from the difference between the respective circumferences measured in not less than two planes perpendicular to the axis of a sample, one plane to be at or near an end.

Filler.

193-8. A filler consisting of a viscous, plastic, non-hardening, moisture repelling, mineral base insulating compound, shall be applied between alternate layers. It shall prevent the tapes from unwrapping when cut and

shall allow the layers to slide on each other when the cable is bent, the whole forming a hard semi-flexible wall of insulation. Neither the varnished cambric nor the filler shall have a deleterious effect on each other or on the copper.

Method of application, cambric.

193-9. The cambric shall be applied in the shape of a tape in such widths that it will lie smoothly and be substantially free from wrinkles. It shall be wound around the conductor helically, tightly, evenly and smoothly, so that it will not wrinkle excessively in bending the cable around the circumference of a diameter equal to eight (8) times the outside diameter of the cable.

No registration.

193-10. There shall be no registration of successive or alternate layers of insulation. A registration shall be considered to have occurred when one or both edges of any tape lie directly over or under, for one complete turn or convolution; (a) the corresponding edge or edges of an adjacent tape, or (b) any part of the gap between two adjacent turns of an adjacent tape.

The interstices in multiple conductor cables shall be filled and rounded out with jute laterals or fillers saturated with a compound similar to that used in filling between the layers of the varnished cambric insulation.

Rubber filled tape.

193-11. A rubber filled tape shall be applied over the varnished cambric before the application of an outer covering on all cables over two (2) inches in diameter. The tape shall have a thickness of not less than ten (10) mils and have not less than fifty-five (55) by sixty (60) picks per inch. It shall be thoroughly filled with a rubber compound and be applied helically with a lap.

Separator.

193-12. A separator will be permitted between the conductors and the insulation, but shall not be included in the determination of insulation thickness.

Tests for flexibility.

193-13. Cable shall be sufficiently flexible to permit bending to a diameter of twelve (12) times its outside

diameter at any temperature between minus 5° C. and plus 40° C. (23° F. and 104° F.). A twelve (12) foot sample shall be selected from each size and subjected to a bending test at minus 5° C. The cable shall be bent 180 degrees around a cylindrical form having a diameter equal to twelve (12) times the outside diameter of the cable and then straightened. It shall then be bent 180 degrees in the opposite direction around the same or similar form and again straightened. This operation shall be performed four (4) times in succession, except that the cable shall not be straightened out to complete the fourth cycle.

The cable shall be so held during the operation that it cannot revolve around its own axis. The sample shall not fail when tested after bending and while in a U form at one and one-half (1½) times the specified test potential for five minutes.

17,000 VOLT CABLE.

Thickness of insulation.

193-14. For 17,000 volt, single conductor, varnished cambric cable, the thickness of insulation shall not be less than fourteen thirty-seconds (14/32) inch.

Thickness of lead sheath.

193-15. For 17,000 volt, single conductor, varnished cambric, lead covered cable, the minimum thickness of lead sheath permissible shall be as follows:

All sizes up to and including 3/0 American Wire Gauge—6/64 inch;

Larger than 3/0 to and including 750,000 circular mils—7/64 inch.

5,000 VOLT CABLE.

Thickness of insulation.

193-16. For 5,000 volt, single conductor, varnished cambric cable, the thickness of insulation shall be not less than three-sixteenths (3/16) inch. For 5,000 volt, 3-conductor, varnished cambric cable, the thickness of insulation shall be not less than three thirty-seconds (3/32) inch on each conductor and a three thirty-seconds (3/32) inch belt.

193-17. For 5,000 volt, varnished cambric, lead covered cable, the minimum thickness of the lead sheath shall be as follows: Thickness of lead sheath.

For all diameters to and including 3/4 inch—4/64 inch;

Larger than 3/4 inch to and including 1.07 inch—5/64 inch;

Larger than 1.07 inch to and including 1.60 inch—6/64 inch;

Larger than 1.60 inch—7/64 inch.

In all cases the diameter given is that of the finished lead covered cable.

3,000 VOLT CABLE.

193-18. For 3,000 volt single conductor varnished cambric cable the thickness of insulation shall be not less than one-eighth (1/8) inch. For 3-conductor cable the thickness of insulation shall be not less than one-sixteenth (1/16) inch to each conductor and one-sixteenth (1/16) inch for the belt. Thickness of insulation.

193-19. For 3,000 volt, single conductor, varnished cambric, lead covered cable, the minimum thickness of lead sheath permissible shall be as follows: Thickness of lead sheath.

All sizes up to and including 1/0 A. W. G.—4/64 inch;

2/0 to and including 350,000 circular mils—5/64 inch.

For 3,000 volt, 3-conductor, varnished cambric, lead covered cable, the minimum thickness of lead sheath permissible shall be as follows:

All sizes up to and including No. 10 A. W. G.—4/64 inch;

No. 8 to and including No. 4—5/64 inch;

No. 2 to and including No. 2/0—6/64 inch.

600 VOLT CABLE.

Thickness of insulation.

193-20. For 600 volt, single conductor, varnished cambric cable, the minimum thickness of insulation shall be as follows:

All sizes to and including No. 8 A. W. G.—3/64 inch;

All sizes larger than No. 8 to and including No. 2—4/64 inch;

All sizes larger than No. 2 to and including 4/0—5/64 inch;

All sizes larger than 4/0 to and including 500,000 circular mils—6/64 inch;

All sizes larger than 500,000 circular mils—7/64 inch.

For 600 volt, 3-conductor, varnished cambric cable, the minimum thickness of insulation shall be as follows:

All sizes up to and including No. 8 A. W. G.—3/64 inch per conductor covered with a cotton tape;

All sizes larger than No. 8 up to and including No. 2—3/64 inch per conductor and 1/64 inch belt;

All sizes larger than No. 2 up to and including 4/0—4/64 inch per conductor and 1/64 inch belt;

All sizes larger than 4/0 to and including 500,000 circular mils—5/64 inch per conductor and 2/64 inch belt.

Thickness of lead sheath.

193-21. Lead covering where called for on 600 volt, single conductor, varnished cambric cable shall be not less than as follows:

All sizes up to and including No. 4—3/64 inch;

All sizes larger than No. 4 up to and including 3/0—4/16 inch;

All sizes larger than 3/0 including 400,000 circular mils—5/64 inch;

All sizes larger than 400,000 circular mils including 1,000,000 circular mils—6/64 inch.

Lead covering where called for on 600 volt, 3-conductor, varnished cambric cable shall be not less than as follows:

All sizes up to and including No. 6 A. W. G.—4/64 inch;

All sizes larger than No. 6 up to and including No. 2—5/64 inch;

All sizes larger than No. 2 up to and including 3/0—6/64 inch;

All sizes larger than 3/0 up to and including 350,000 circular mils—7/64 inch.

Braided covering.

193-22. Where lead covering is not called for, varnished braided cambric cable shall have a braided covering. All 3-conductor cable shall have a double braid. All single conductor cable larger than No. 8 A. W. G. shall have a double braid. Where flame-proof cable is specified, the braid shall be impregnated with a fire resisting compound.

600 volt cable shall in all cases be braided unless specified to the contrary.

PAPER INSULATED TELEPHONE CABLE.

General.

193-23. The cables specified herein will be used for telephoning, for the operation of relays and for indicating lights. They will convey alternating and direct current at voltages up to 150 volts. After installation each cable shall contain at least as many good wires as specified.

Size of conductors.

193-24. Each conductor shall be No. 22 A. W. G. approximately 0.02535 inch in diameter and 642 circular mils average section.

Insulation.

193-25. Each wire shall have two wrappings of paper applied spirally, the two wrappings applied in opposite

directions. Each paper shall be not less than 0.0035 inch thick by approximately 1/2 inch wide.

Laying up cable.

193-26. The separate conductors forming a cable will be used for different services. For purposes of segregation, a portion of the wires forming the cable shall be laid to form a complete separate cable and shall be covered with a wrapping of paper applied spirally to make up a radial thickness not less than 1/64 inch.

To form another section, a portion of the remaining wires shall be laid on these adjacent layers in reverse lay until the total number specified for this section is complete and when so complete, a second similar wrapping shall be applied. The number of such sections for each cable shall be as specified hereinafter.

Lead sheath.

193-27. The cable so formed shall be incased in a lead sheath having a minimum average thickness as follows:

All diameters up to 1/2 inch—2/64 inch;

All diameters over 1/2 inch not exceeding 1 inch —4/64 inch;

All diameters over 1 inch—6/64 inch.

These diameters are the diameters after the core has been completely assembled ready for the lead sheath.

The sheath shall be free from holes and other defects, non-porous, of uniform thickness and composition. The minimum thickness of sheath shall be not less than ninety per centum (90%) of the nominal.

Electrostatic capacity.

193-28. The average electrostatic capacity shall not exceed 0.070 microfarads per mile, each wire being measured against an adjacent wire, the remaining wires being grounded. The maximum electrostatic capacity shall not exceed 0.080 microfarads per mile.

Insulation resistance.

193-29. Each conductor shall show an insulation resistance of not less than 500 megohms per mile, measured at 68 degrees F., each wire being measured against the rest of the wires and the sheath grounded.

Temperature for tests.

193-30. The electrostatic capacity and the insulation resistance shall be measured at a temperature not lower than 68 degrees F. If the cable when measured at a temperature higher than 68 degrees F. fails to meet the requirements, no temperature correction shall be applied, but in such case the cable may at the option of the manufacturer be retested at a temperature not lower than 68 degrees F.

High potential tests.

193-31. Each conductor in the cable shall withstand without rupture of the insulation a high potential test at the factory of 1000 volts A. C. applied for one (1) minute between each conductor and the other conductors or, at the option of the Engineer, the lead sheath. After installation each conductor shall withstand a similar test at 60 cycles.

Capacity and resistance to remain constant for one year.

193-32. The electrostatic capacity shall not increase nor shall the insulation resistance decrease beyond the limits above specified for one (1) year after the cable has been installed and accepted.

Retests.

193-33. If the requirements of these specifications are not met at the first test, a second test will be made. All lengths failing to pass the second test will be rejected and if delivered at the site of the work shall be removed.

Splices.

193-34. Splices in telephone cable shall provide conductivity, insulation and dielectric strength equal in amount to the average required in equal lengths of cable.

No splices will be permitted in the ducts and not more than one splice per cable in each splicing chamber. In making the splice the lead sleeve shall be removed with care so as not to injure the paper insulation and the exposed conductors thoroughly boiled out by pouring hot paraffine over them until all traces of moisture are removed. Paraffine shall be of refined grade and its boiling temperature above that of water but not high enough to scorch the paper insulation or make it brittle.

In making the splice the two cables shall be placed and firmly held in the same straight line and after removing the paper insulation the different conductors shall be joined by a twist joint. The joints in each conductor shall be covered by a cotton sleeve and the sleeves neatly arranged in rows after which the joint shall again be boiled out with paraffine until all traces of moisture have been removed and wrapped with strips of muslin or its approved equivalent to bind the wires together. The whole shall be finally covered with a lead sleeve, the ends of which shall be carefully fitted over the sheath of the cable and a tight, wiped joint made to the sheath. Should voids subsequently appear in the joint, the joint shall be made over. Patching with a blow torch will not be permitted.

Wherever in the tunnel or elsewhere a tap of rubber insulated cable is made to a paper insulated cable, the splice in the paper insulated cable shall be filled with boiling paraffine. After the lead sleeve is in place and wiped to the sheath, two holes shall be cut in the sheath and the entire joint filled with paraffine. After this has cooled and settled voids shall be refilled in the paraffine and the openings in the sleeve sealed.

Insulating paper.

193-35. Insulating paper less than 0.005 inch thick shall be of clear rope stock or of clear rope with an admixture of not more than twenty per centum (20%) by weight, of high grade cotton rag.

Insulating paper 0.005 inch thick or more shall be of clear rope stock with an admixture of not more than forty per centum (40%) by weight, of chemical wood pulp.

By clear rope stock is meant stock composed of manila rope or of manila rope and hemp. Jute and sisal shall not be added. The paper shall be free from sizing and loading materials.

Chemical wood pulp shall be made by the soda or the sulphate process from spruce or other coniferous wood

having equivalent fiber. Material treated by the sulphite process shall not be used.

RUBBER COVERED WIRE.

General.

193-36. Rubber covered wire for house and tunnel lighting and for other miscellaneous purposes shall comply with the requirements of the National Electric Code for rubber covered and braided wire of the thickness specified for 600 volts.

Wire, size No. 10 A. W. G. and larger, shall be stranded.

Mains.

The mains for the tunnel lighting shall consist of three wires, one of which shall be smaller than the other two. The two of the same size shall have different colored braids or shall be marked in some other approved manner to insure making the correct connections at the pull boxes.

Branches.

The two wires in the branches shall have different colored braids or be otherwise distinguishable and one of the two colors shall consistently be used at all connections to the mains to connect to the neutral main.

Rubber covered control cable.

193-37. Rubber covered multi-conductor 19/25 or 19/22 cable for control purposes shall be suitable for 600 volt service. The thickness of the rubber shall comply with the requirements of the National Electric Code. The rubber shall be protected with a braided cover. Each wire in a cable shall have a distinctive coloring.

Rubber covered telephone wire.

193-38. Rubber covered multi-conductor wire extending across the tunnel from the paper insulated cable to the telephone niche, shall be suitable for 150 volt service. Each wire shall have a distinctive braided covering. Thickness of rubber shall be not less than one thirty-second (1/32) inch.

Cabinet wiring.

193-39. Where rubber covered wire is specified for relay cabinets, switch cabinets or for other control purposes,

it shall be braided, multi-colored, suitable for 150 volt service. Thickness of rubber shall be not less than one thirty-second (1/32) inch.

Rubber requirements.

193-40. All rubber shall be thirty per centum (30%) Hevea, complying with the requirements of the Joint Rubber Committee for Grade A rubber and shall pass all tests for such insulation specified by the American Institute of Electrical Engineers.

INSTALLATION OF WIRES.

Conduits.

193-41. Except where shown on the drawings or where specified to the contrary, all wires shall be placed in conduit.

All the conduit for the tunnel and plaza lighting, for the house lighting and for the telephones has been or will be furnished under other contracts.

With few exceptions as shown on the drawings or as specified herein, all conduit for the power, control and auxiliary wiring has been or will be furnished by the Commissions under other contracts.

The conduit so furnished includes pull, outlet and junction boxes.

After being concreted in, the conduits have been or will be tested under another contract by drawing through them a twenty (20) foot length of three wires of the following sizes, each separate wire rubber insulated according to the National Electric Code for 600 volts:

¾ inch	No. 10 A. W. G.
1 "	No. 8 "
1½ "	No. 1 "
2 "	No. 3/0 "

and larger sizes with a globular mandrel one-half (½) to one-quarter (¼) inch smaller in diameter than the conduit.

The Contractor shall snake and properly clean all conduits before pulling in the wires. All the wires of the circuits to be installed in the conduits shall be pulled at the same time.

All wire shall be continuous without splices between junction boxes. Power wiring shall be continuous without splices from switch terminal to the apparatus. Sufficient slack shall be left at junction boxes and at terminals for splicing the wire and for making the proper connections.

Joints.

193-42. Joints shall be of the Western Union type, carefully spliced and soldered using a non-corrosive flux and insulated, observing the following instructions:

(a) The braid shall be stripped back at least one inch from the end of the rubber and the rubber insulation beveled with a sharp knife similar to sharpening a lead pencil, care being taken not to ring or to notch the conductor;

(b) In making the joint, the wires shall be twisted around each other and carefully soldered and wiped. Care shall be taken that the ends of the wires do not protrude and that the solder is wiped smooth;

(c) Before taping the rubber insulation, the conductors shall be covered with a thin coat of pure rubber cement and allowed to set for about one minute;

(d) Not less than three layers of pure rubber tape shall be wrapped around the joint and the insulation with the turns overlapping. The tape shall be applied under tension. The thickness of the insulation thus obtained shall be at any place not less than that of the insulation of the larger of the wires spliced;

(e) The whole joint shall be covered with two layers of approved friction tape and painted with a heavy coat of approved insulating paint.

Ground cables.

193-43. Whenever a ground cable provided under other contracts or hereunder is connected to apparatus

to be grounded or to a ground bus, the cable shall be provided with a terminal, bolted and soldered to the apparatus so connected.

POTHEADS.

13,200 volt type.

193-44. Potheads for installation on the lead covered cable for 13,200 volt service in the land ventilation buildings, shall be of the indoor single conductor type, straight, to be mounted vertically or horizontally as required and suitable for wiping to the lead sleeve of the cable. Bushings shall be porcelain, threaded or cemented in the top. Bells and tops shall be non-magnetic. The extension of a conductor through the pothead need not be a separate conductor but shall be taped and painted.

6,600 volt disconnecting type.

193-45. Potheads for installation in the New York and New Jersey administration buildings and in the transformer room at the New York portal of the north tunnel under Items 195 and 196, shall be of the disconnecting type suitable for 6,600 volt service.

They shall have metal bells and non-magnetic tops with corrugated porcelain bushings, threaded or cemented into the tops. The extension from the cap to the bus shall be flexible.

The distance between centers of conductors at the outlets of the bushings shall be not less than seven and one-half (7½) inches.

The construction of the pothead shall be such that no live metal is exposed on the outside or can be reached by water when entirely immersed. The outlets shall be sealed mechanically against the entrance of water, independently of the filling compounds.

Disconnecting potheads shall be complete with male, female and dummy parts. They shall permit opening and closing the circuits safely while the latter are alive. The dummy holder shall hold the cap rigidly in place.

Insulators and bushings.

193-46. Bushings for potheads and insulators for supporting the connections between transformers and floor bushings shall be of porcelain. The surface shall be smooth, uniform in color, without surface spots, bubbles or other imperfections which might adversely affect its value. The insulators and bushings shall be thoroughly vitrified and homogeneous and shall not absorb moisture. A fragment from the interior of the insulator or bushing, presenting only broken surfaces, after being dried in a temperature of not less than 120° C. for not less than 36 hours, or as much longer as is necessary to reduce its weight to a minimum, when immersed in water at a temperature of 20° C. to 40° C. for 72 hours, its surface carefully dried and then weighed, shall not show an increase in weight of more than five-tenths of one per centum (0.5%).

In 13,200 volt service, porcelain bushings and insulators for use in potheads and for supporting the cables and transformer connections, shall be suitable for 15,000 volt service, shall have a creepage distance of not less than six (6) inches and shall withstand a tensile test of three thousand (3,000) pounds per square inch and a cantilever test of two thousand (2,000) pounds per square inch. The dry flashover voltage shall be not less than 90,000 volts and the puncture voltage at least fifty per centum (50%) in excess of this.

Porcelain bushings and insulators for use in 2,300 volt, 440 volt and 220 volt service shall be suitable for 6,600 volt service. They shall have a creepage distance of not less than four and one-quarter (4¼) inches. The dry flashover voltage shall be not less than 45,000 volts and the puncture test at least fifty per centum (50%) in excess thereof. Post insulators shall withstand a tensile test of 3,000 pounds and a cantilever test of 1,400 pounds. They shall have two (2) holding bolts.

Brackets and holding bolts.

193-47. Brackets and holding bolts shall be provided for the potheads and insulators at all points.

Payment, wire and cables.

193-48. No separate payment will be made for the wire, cables or potheads specified under this item, but payment therefor is deemed to be included in the lump sum prices stipulated in the Schedule, which prices shall be in full compensation for furnishing and installing the wire and cables, complete, and all expense in connection therewith or incidental thereto including potheads, splicing and testing.

ITEM 195—TUNNEL LIGHTING.

Scope of the work.

195-1. The work under this item is for convenience divided into four sections, tunnel lighting proper, tunnel signals, lighting of certain rooms and automatic fire alarms. The tunnel lighting to be installed hereunder comprises all details necessary for the lighting of the tunnel excepting the high voltage supply cables, but it includes connecting the transformers to the supply.

Drawings.

The work to be done under this item is shown on drawings Nos. 2, 3, 17, 18, 19, 22 to 27 inclusive.

Tunnel lighting.

195-2. Under tunnel lighting proper the Contractor shall furnish and install the transformers listed below, the panel boards and cases therefor, the low voltage wires, including mains and branches, switches, fuses, circuit breakers, terminal boards, except the terminal strips in the relay boxes, all reflectors for tunnel lights, receptacles and bulbs for the same, receptacles, conduits and bulbs in the fire extinguisher niches, steel brackets and supports in the fire extinguisher niches for carrying the fire extinguishers or for protecting the lights and all interconnections to the source of supply. In the New York and New Jersey administration buildings he shall provide and install a small amount of 2,300 volt bus equipment.

Signal equipment.

195-3. The signal equipment includes the signal units in the tunnels and at the entrances, push buttons in the tunnels for controlling the signals and part of the wiring.

Rooms to be lighted.

195-4. The rooms to be lighted comprise the pump rooms at the eight shafts, the mid-river pump chamber,

the water meter rooms at the New York entrance and exit, the transformer room at the New York entrance. The lighting of the transformer rooms in the administration buildings in New York and New Jersey will be provided under other contracts. The lighting of the transformer rooms at the various shafts will be provided under Item 198 of this contract.

Wires to be installed in conduit.

195-5. All wires shall be installed in conduit, all of which with slight exceptions as specified hereinafter or as shown on the drawings, have been installed under other contracts. The conduit installations are imbedded in concrete and are complete with pull boxes, junction boxes and outlet boxes. Conduits have been tested for size and continuity since installation as described in paragraph 193-41. In practically all places these conduits are in the ceilings.

TUNNEL LIGHTING PROPER.

General description.

195-6. The tunnel lighting consists essentially of two independent, three-wire, 220/110 volt systems, each feeding alternate lights in each tunnel. Each system is complete with separate wires, conduits, pull boxes and fuses, one system being fed from transformers principally located in the south tunnel and the other from transformers principally located in the north tunnel. Each transformer lowers the pressure from 2,200 volts to 220/110 volts, three-wire, and feeds the tunnel wiring through switches.

High voltage equipment provided.

195-7. At nine transformer locations there have been provided, under another contract, 2,300 volt bus bars, disconnecting potheads and high voltage cable extensions, to which the Contractor shall connect the transformers.

High voltage equipment to be provided.

195-8. In the New Jersey administration building the Contractor shall install 2,300 volt, 3 phase busses as shown on the drawings. In this building the various structural

features, including walls, partitions, conduits and structural steel, will be constructed under another contract. The Contractor shall furnish and install the bus bars, insulators, potheads, cable connections, oil switches and transformers. Part of the equipment shown on the drawings is required for tunnel lighting and part for the plaza lighting, but for convenience all of the equipment will be paid for under Item 195, excepting the two 15 kva transformers and the connection of six plaza lighting cables to the busses as shown on the drawings which will be paid for under Item 196.

The installation in the New York administration building shall be similar to that in the New Jersey administration building and shall follow the one-line diagram shown on the drawings. All the work in the New York administration building will be paid for under Item 195.

At the New York portal of the north tunnel the Contractor shall install potheads and cable extensions for one of the transformers located there as shown on the drawings.

Busses shall be 3/0 solid copper wire, insulated for 3,000 volts with varnished cambric and covered with flame-proof braid. Insulators and potheads shall conform to the requirements specified under Item 193.

Oil circuit breakers.

The two oil circuit breakers for installation in the New Jersey administration building shall be automatic, electrically and manually operated and provided with instantaneous, hand reset overload protection. They shall have a continuous carrying capacity of 300 amperes at 2,500 volts and an interrupting capacity of 6,000 amperes. The electrical operating device shall be suitable for operation from a 220 volt, 60 cycle source.

Near each oil circuit breaker shall be mounted an instrument potential transformer, 2,200/220 and one relay of the type specified in paragraph 195-12. This will be paid for under Item 195.

Mounted on the switch frame shall be five (5) auxiliary contacts, three (3) normally open and two (2) normally closed. Mounted near the switch, on a slate panel, shall be three relays for the remote control of the switch.

These relays are specified under Item 201 and will be paid for thereunder.

Size and location of transformers.

195-9. The number of transformers and the size of each, at the various locations, shall be as follows:

New York entrance plaza, 2 transformers, 25 kva each;

New York administration building, 2 transformers, 25 kva each;

New York north land shaft, 1 transformer, 50 kva;

New York south land shaft, 1 transformer, 50 kva;

New York north river shaft, 1 transformer, 75 kva;

New York south river shaft, 1 transformer, 75 kva;

New Jersey north river shaft, 1 transformer, 75 kva;

New Jersey south river shaft, 1 transformer, 75 kva;

New Jersey north land shaft, 1 transformer, 50 kva;

New Jersey south land shaft, 1 transformer, 50 kva;

New Jersey administration building, 2 transformers, 37.5 kva each and 1 transformer, 25 kva.

The transformers shall be oil insulated, self-cooled. The primary shall be for 2,300 volts and the secondary for 230/115 volts, 3 wire. All shall be single phase except one 25 kva transformer in each administration building which shall be 3 phase or 3 single phase.

Transformer connections.

195-10. The Contractor shall connect the transformers to the cable extensions furnished therefor, by means of bolted terminals to be furnished by him. The connections shall be taped for 3,000 volt insulation. The work of installation shall include grounding the transformer frames.

Entrance to transformer rooms.

The attention of the Contractor is called to the fact that entrance to many of the transformer rooms is constricted. Drawings showing the conditions may be seen in the Engineer's office.

Switch panel cabinets.

195-11. Near the transformers shall be located switch panels mounted in cast-iron cabinets substantially as shown on the drawings and as described herein.

The cabinets shall be divided horizontally into three compartments, the circuit breaker compartment and two switch compartments. The three compartments shall be completely divided from each other so that a flash occurring in one cannot communicate to the other.

The circuit breaker compartment shall be divided vertically into two parts.

Equipment in switch panel cabinets.

195-12. The equipment in the various switch panel cabinets shall be as shown on the drawings. The lamps and push button control switches in the cabinets are for maintenance purposes to determine if the various circuits are alive. The lamps shall be 110 volt, 25 watts. The switches shall be spring return, of the industrial control type. When pressed, each shall ground four independent 125 volt, 5 ampere circuits.

The relays are for supervisory purposes. The operating coil shall be for continuous service on 220 volt A. C. On failure of voltage, they shall make a 125 volt, 5 ampere circuit. When energized they shall break this circuit and make another one, one pole being common to both circuits, thus operating like a single-pole double-throw switch. Where two circuit breakers are called for on the drawings, the second breaker shall be placed in the position occupied by the relays, as shown on the drawings, and the relays shall be placed in an approved location elsewhere in the cabinet. These relays shall be furnished and installed under this item.

Terminal boards shall comply with the requirements specified in paragraphs 200-5, except that they shall have no disconnecting switches. They shall provide terminals for all relays mounted on the panel.

Circuit breakers shall be automatic, opening on overload and shall have copper to copper main contacts and copper to carbon or carbon to carbon break.

Circuit breaker cases.

195-13. In the New York entrance plaza, in addition to the switch panels as above described, there shall be three 2-pole, remote controlled, 200 ampere, 250 volt, 60 cycle, A. C. air circuit breakers, mounted in three cast-iron cases; in the New York administration building, two such breakers and in the New Jersey administration building, one such breaker. The doors of the cases shall be hinged and provided with a latch. Operating voltage of the coils shall be 110 or 220 volt, 60 cycle, A. C.

The breakers shall have five auxiliary contacts, three normally open and two normally closed. The breakers shall be back connected, non-automatic; otherwise they shall be as specified for the breakers in the control cabinets.

Mounted below each breaker shall be three relays for supervisory and operating purposes. These relays are specified under Item 201 and will be paid for thereunder. Terminal boards shall be furnished in each case, to be similar to those specified in the preceding paragraph.

Erection of busses, transformers and switch panels.

195-14. The work to be done at the New York portal to the north tunnel, and the work to be done in the New Jersey administration building, is as shown on the drawings. The work to be done in the New York administration building shall be like that in the New Jersey administration building and at other locations similar to the New York portal, except that no potheads are required. At each of the four river shafts, a total of 60 feet of three (3) inch conduit and 20 feet of four (4) inch conduit is required and at each of the four land shafts 20 feet of two (2) inch conduit are required.

The work of erection shall include mounting the case in place, grouting it in position, furnishing and installing the ground bus and connecting it to existing ground cables, grounding the cases of the circuit breakers and connecting all cables to the proper terminals. It shall include the furnishing and installing of exposed conduit

with fittings, between the wall and the case. The power and control cable shall be furnished under Item 199.

Distribution system.

195-15. Each 220/110 volt distribution system consists of three-wire mains of sizes shown on the drawings, the two outer wires being of larger size than the neutral. The mains shall consist of three separate wires, or at the option of the Contractor, of one three-conductor cable. At intervals, usually measuring 120 feet, a two-wire branch shall be tapped on these wires between the neutral and one of the outers. The connection shall be made at a ceiling box 8 inches by 12 inches by 4 inches deep which has been provided under another contract. The branch shall be fed through a fused switch. The fused switch and terminal board described hereinafter shall be mounted in a ceiling box 6 inches by 10 inches by 4 inches which has been provided under another contract. From this branch the tunnel lighting shall be fed and connections made to heaters in fire extinguisher niches, to relay boxes for the traffic signals and to plug receptacles.

The branch wire shall be No. 10, A. W. G. The two wires shall be distinguished by the use of different colored braids and one color shall consistently be connected to the neutral main.

The two outer mains shall be of different colors, or marked in some other approved manner to distinguish them apart. In conjunction with the smaller size of the neutral, this will distinguish the three wires and simplify making correct connections.

Care shall be taken to insure that each branch is connected to the particular outer main as directed by the Engineer.

Wires shall be rubber insulated with 30% rubber and double braid as specified under Item 193.

Fused switch.

195-16. The fused switch for feeding the branches shall be 30 ampere, 220 volt, National Electric Code Standard,

mounted on a base of porcelain or approved molded material. Fuses shall be of the cartridge type. Mounted with the switch itself shall be a small terminal board of approved molded material. The work of installation shall include drilling and tapping the boxes for the screws holding the switch base.

Tunnel lighting units.

195-17. The tunnel lighting unit consists essentially of a lamp and reflector mounted in a cast-iron box which is provided with a glass cover. This cast-iron box has been provided under another contract and is wholly imbedded in concrete. When the box was made, tapped holes were provided around the sides to receive the screws holding the reflector in place.

Hardened set screws were placed in these holes of which many have rusted fast. It may be necessary to drill these screws out and the Contractor must make his own estimate of the difficulties which will be encountered in removing them, as no separate payment will be made for this work.

The glass cover is mounted in a hinged bronze frame fastened in position by screws and has been provided under another contract.

In working in and about the light boxes, the Contractor shall exercise due care not to break any of the glass covers. He shall be responsible for their safety and shall replace all those broken until the final completion of this contract.

The receptacles shall be mounted on the reflector as shown on the drawings.

Reflectors.

195-18. Reflectors for tunnel lights shall be of cast iron, enameled, of the dimensions shown on the drawings. Castings shall be regular in shape and shall conform to the requirements for cast iron specified under Item 90. Before being enameled, the reflecting surface shall be ground, annealed, sand blasted and filled to present a smooth surface for the enamel. All enameled surfaces shall be completely covered so that corrosion cannot start

on the surface. The enamel shall be a high grade white coat of the kind best suited for light reflection and equal to the best bath tub enamel. The finished coat shall be free from pits, dark spots, specks or uneven lumps and runs. Failure to comply with these requirements shall be sufficient cause for rejection, and all rejected parts shall be replaced with perfect pieces without delay. With every mix shall be made one flat sample four (4) inches square. This shall show a coefficient of reflection not less than 75%. Failure to pass this test shall be cause for rejection of all reflectors from the mix. If twenty per centum (20%) of the reflectors in any shipment are found to be imperfect, all reflectors in that shipment may be rejected.

Receptacles.

195-19. The receptacles shall be of porcelain. They shall be of such design and so mounted in the reflector as to prevent the passage of air between the spaces in front and in back of the reflector. The gasket between the reflector and the receptacle shall be asbestos fiber or other heat resisting material. The receptacles shall be of the waterproof type, all live parts in the back being covered with insulating material which will not soften or deteriorate at the high temperatures which might be experienced in case a 200 watt light is used in the reflector. The terminals of the receptacles shall be covered with fire resisting insulation, without any rubber or other material which will deteriorate at high temperatures.

Lights.

195-20. Bulbs for tunnel lights shall be one hundred ten (110) volt, one hundred fifty (150) watts, medium screw base, adapted for parallel burning.

Fire extinguisher niches.

195-21. Fire extinguisher niches shall be wired with two No. 10 wires to the lighting circuit branch as shown on the drawings. In each niche shall be a lamp receptacle mounted in a conduit fitting. All wires within the niche shall be mounted in steel conduit. Under another contract the conduit has been brought to the niche. The

Contractor shall supply all conduit, conduit fittings, switches, wires and lamps in the niche. The size of the light shall be as shown on the drawings. The Contractor shall also supply a shelf and support for fire extinguishers and all steel work as shown on the drawings.

Relay boxes.

195-22. Each relay box shall be connected with a branch lighting circuit of each of the two tunnel lighting systems as shown on the drawings, each connection to consist of two No. 10 wires. In the relay box these wires shall be connected to the terminal block specified hereinafter under Item 201.

Plug receptacles.

195-23. At certain points shown on the drawings, the Contractor shall wire up plug receptacles that have been provided under other contracts. At certain points as shown on the drawings, he shall provide plug receptacles and wire them. These shall be similar to the existing receptacles, which are of Lovell make.

TUNNEL SIGNALS

General.

195-24. The tunnel signal system consists essentially of three parts, traffic signals, tunnel fire alarm signals and call signals. The equipment to be supplied under this item includes the traffic signal boxes and operating buttons. The signals are controlled locally and from a chief operator's room. The local stations are approximately 450 feet apart, adjacent to the tunnel telephone stations. Grouped at a station are a relay box, a telephone box and an alarm box, which have been furnished, but not equipped, under another contract; and a traffic signal box and a call signal box to be furnished and equipped hereunder. Half way between these stations are repeat signals which repeat the indication of the traffic signal toward the exit but which have no separate control.

Traffic signals.

195-25. The traffic signal shall consist of colored lights and of word signals mounted in a box attached to the ceilings, of design and construction as shown on the drawings and as described hereinafter.

Color light signals.

195-26. The color light signals for the tunnel shall consist of a bronze box bearing two lenses mounted in the front of the box, facing the traffic, one red, and one green, complying with the latest specifications of the signal section of the American Railway Association; also two lenses of the same color mounted in the back of the box to serve as an indicator to the traffic officer in case he is back of the signal. All lenses shall be of the sizes shown on the drawings. The box shall be divided into two compartments, one for each color signal. Back of each front lens shall be placed a 10 watt light. This shall be located at the focus of the lens. The back of the box shall be hinged and fastened with a spring snap.

The mounting of the box on the ceiling shall be such as to permit a slight adjustment about the vertical axis so as to range the lights in the proper direction.

The work of installation shall include drilling the tiles and ceiling for the bolts holding the box in place, furnishing the expansion bolts, drilling the cast-iron cover of the ceiling pull box, furnishing conduit connections thereto and furnishing all electrical connections.

Word signals.

195-27. The word signal shall consist of the words "Stop Engine" in letters of the size shown on the drawings, mounted in a box attached to the box carrying the color light signal. The interior of the box shall be illuminated as shown on the drawings. The construction of the side of the box carrying the words, shall be as shown on the drawings or an approved equivalent. A sample box shall be submitted for approval.

Call signals.

195-28. The call signal shall consist of lights with colored lenses mounted in a bronze box at the local tunnel telephone station. The box shall be as shown on the drawings. Lenses shall be two inches in diameter. Two shall be yellow and two blue. Directly above the proposed location of the relay box a conduit projects from the face of the tile. The call signal box shall be fastened to the

tile completely covering the end of the conduit. The Contractor shall bush the end of the conduit.

Operating buttons.

195-29. The operating buttons shall be as shown on the drawings. They shall be mounted in the alarm box at each signal station and shall be spring return. When pressed they shall make one circuit and break two circuits. They shall be of the industrial control type. Contacts shall be rated at five amperes. The enamel of the front plates shall be equal to the best bath tub enamel.

Wiring.

195-30. The number and size of the wires from the lighting conduits to the relay box, from the relay box to the traffic signal and call signal and between traffic signals shall be as shown on the drawings. They will be paid for under Schedule Item 195.

The wires from the relay box to the alarm box and to the telephone box, and the control wire from the chief operator's room to the relay box, will be paid for under Schedule Item 197. The relays, the control apparatus in the chief operator's room, the alarm equipment in the chief operator's room and the terminal strip in the relay box, will be paid for under Schedule Item 201. The automatic fire alarms in the various sumps, including the mid-river sump, will be paid for under Schedule Item 195.

WIRING OF ROOMS.

General.

195-31. The equipment required for the various rooms to be wired under this item is included in the schedule listed in paragraph 195-35. All switches shall be push button or tumbler type and all fixtures shall be vapor proof and provided with guards.

AUTOMATIC FIRE ALARMS.

Automatic fire alarms.

195-32. In the eight (8) sumps at the shafts below the pump rooms and in the sump below the mid-river pump chamber, the Contractor shall furnish and install an auto-

matic fire alarm system. The protection shall be of the Derby or other approved system of the closed circuit type. The rooms to be protected measure about twenty (20) feet by thirty (30) feet. Detectors shall be placed on about ten (10) foot spacing with a total of forty-eight (48) in the eight (8) sumps and four (4) in the mid-river pump chamber.

The work shall include all local apparatus and the design shall conform to the design of the tunnel signal control as specified in Item 201 and announcement shall be made by opening a 60 volt D. C. circuit. The announcing apparatus in the chief operator's room shall be provided under Item 201. The connecting wires between the various pump rooms and the chief operator's room will be part of the telephone cable to be supplied under Items 197 and 199, consisting of No. 22 wire and the chief operator's room will, in some instances, be 7,000 feet from the apparatus. The power available for the operation of the system consists of a 60 volt, D. C., polarized circuit supplied through a No. 22 A. W. G. wire.

GENERAL.

195-33. All apparatus required hereunder shall be as shown on the drawings.

Tests.

195-34. After installation, the insulation of all apparatus except the transformers, shall be subjected, for a period of one (1) minute, to a test voltage of 1,200 volts, A. C.

Equipment to be furnished.

195-35. For the convenience of the Contractor in preparing his proposal, the principal items of the equipment to be furnished and installed by him under this item of the contract are summarized herewith. The Contractor shall check these figures against the drawings and in case of any discrepancy, the drawings shall govern.

ITEM	Number Required	Shown on Drawing No.	Specified in Paragraph No.
2,300 volt bus bars	2	18	195-8
Transformers	16		195-9
Switch cabinets	12	19	195-11
Circuit breakers, remote controlled	6		195-13
Potheads, 3 phase	12	18	195-8
Potheads, single phase, wiped joint	12	18	195-8
Potheads, single phase, without wiped joint	17	17 and 18	
Potheads, dummies	56	17 and 18	195-8
Fused switches for tunnel lights	289	25, mark S	
Reflectors for tunnel lights	1768	22	
Fire extinguisher niches, Type B, 5 unit	59	26	
Fire extinguisher niches, Type C, 3 unit	41	26	
Fire extinguisher niches, Type A, single unit	124	26	
Plug receptacles, supplied and wired	39	25, mark L	
Plug receptacles, wired, not supplied	58		
Tunnel signal boxes	84	23	
Traffic officers' signals	43	25, mark T	
Signal control boxes	43	27	
Lighting fixtures	60	25, mark H	
Lighting switches	17	25, mark M	
Exit lights	8	25, mark X	
Exit light receptacles	3	25, mark P	
Automatic fire alarms	9		195-32

WIRE AND CABLE.

Size (A. W. G.)	Total length in feet
4/0	19,000
1/0	27,500
2	9,800
6	27,000
8	53,000
10	148,000

Payment, tunnel lighting.

195-36. Payment for tunnel lighting will be made at the lump sum price stipulated in Schedule Item 195, which price shall be in full compensation for furnishing all the material for, and installing the tunnel lighting in accordance with the drawings and as herein specified, complete, including the signals, lighting of the rooms and automatic fire alarms specified in paragraphs 195-24 to 195-32 inclusive, and all expense in connection therewith or incidental thereto, except such items for which payment is otherwise provided in paragraph 195-30, but including removing the set screws from the cast-iron light boxes referred to in paragraph 195-17.

ITEM 196—PLAZA LIGHTING.

Scope of the work.

196-1. The lighting to be furnished and installed by the Contractor under this item includes that of the New York entrance plaza, the New Jersey entrance and exit plazas and the open cuts at the New York and New Jersey entrances and exits.

System.

196-2. The lighting system shall be 3 wire multiple 220/110 volt in one-light and two-light standards fed from step-down transformers. In New Jersey the transformers and the 2,300 volt cables feeding them shall be furnished under this item. In New York the transformers shall be furnished under Item 195.

Work done under other contracts.

196-3. Under other contracts will be furnished the underground conduits and ducts, the manholes, the pull boxes and the lighting standards, but without the wiring

therefor or the lighting fixtures, except that temporary lighting standards for the New York exit open cut shall be furnished hereunder.

Work to be done under this contract.

196-4. Under Item 195 of this contract 2,300 volt busses shall be furnished in the New Jersey administration building and switch cabinets furnished in the New York entrance plaza and the New York administration building.

Under this item the Contractor shall furnish in the New Jersey administration building, the 15 kva transformers and the distribution cables with the potheads and connect them to the busses.

In New York, he shall supply the distribution cables and connect them to the switches in the cabinets in the entrance and in the administration building.

In the plazas and open cuts, he shall furnish the high tension and low tension cables, transformers, section boxes, lamps, cutouts, wiring for standards and lighting fixtures complete and in the New York exit, the temporary light standards.

2,300 volt cable.

196-5. The 2,300 volt cables in the New Jersey plaza will supply energy to transformers located in manholes which in turn will feed the lights through a three-wire distribution. They shall be cambric insulated for 3,000 volts, lead covered, single conductor, complying with the requirements specified under Item 193 and of the sizes and lengths listed in the wiring schedule. At the transformers in the manholes the lead sleeve shall be wiped to the transformer casing so as to form a water-tight joint. In the entrance plaza switch room the cable shall terminate in a disconnecting pothead.

Transformers.

196-6. There shall be eight (8) single phase transformers each of 15 kva capacity. They shall be of the subway type which can withstand total immersion for long periods without injury. Six (6) will be located in manholes and two (2) in the New Jersey administration building. The Contractor shall ground the transformer cases to existing

grounds. They shall be oil immersed, self cooled, single phase, for 60 cycle, 2,300 volt primary, 230/115 volt, 3 wire secondary.

Distribution system.

196-7. The 220/110 volt distribution system consists of 3 single-conductor cables from the transformer to a section box from which two 3-conductor branch circuits are brought out to feed the lights. Each 3-conductor, lead covered branch cable is brought successively to each light on the circuit. Under another contract conduits for this purpose will be laid in concrete between the posts and turned up to a point within the base of the lighting standard, or to a box at the base of the temporary standard.

Section boxes.

196-8. The section boxes shall be for two 100 ampere, double fused circuits. They shall be of the subway type and shall be able to withstand immersion for long periods without injury. Terminals shall be suitable for sweating thereto the lead sleeves of the cables. The Contractor shall ground the box to existing grounds. Bolted links or knife switches shall be furnished to disconnect the neutrals inside the box.

Distribution cables.

196-9. The 220/110 volt distribution cable shall be rubber insulated, lead covered. The sizes and the number of conductors per cable shall be as shown in the wiring schedule. Where the cable terminates at a fuse box or other underground point, the lead sheath shall be sweated to the casing. Where the cable terminates in a lamp standard or other place above ground, no pothead shall be supplied, but the lead sleeve shall be belled out and the cable shall be taped up and made watertight.

Switches in light standards.

196-10. Mounted in the base of each two-light standard shall be a 3-pole, single-throw, double-fused switch, of 30 ampere, 250 volt capacity, for disconnecting the light. Mounted in the base of each one-light standard for plaza lighting, shall be a 2-pole, single-throw, 30 ampere, 250 volt, fused switch.

The switch shall be mounted on a suitable base and fastened in the light standard in a suitable manner. Mounted near the base of each standard along the open cuts will be a cast-iron box to be furnished under another contract. This box terminates the conduit runs between lights and is connected by a conduit to the standard. The Contractor shall mount in the box a 2-pole, single-throw, fused switch of 30 ampere, 250 volt capacity.

Light standard wiring.

196-11. From the switches in or near the base of the standard there shall be a 2-conductor cable to each light. These shall be No. 14 A. W. G. wire, rubber insulated, braided, suitable for 600 volt service, lead covered in a flexible steel conduit (Type BXL, or equal).

Lighting fixtures.

196-12. The lighting fixtures for the two-light standard and for the one-light standard shall be of the design and dimensions shown on the drawings. The outer glass shall be opalescent, suitable for street lighting fixtures and of a kind which will cause diffusion of the light.

The bulb shall be mounted within a glass refractor which shall throw the maximum light downward on the street surface. This result shall be still further enhanced by a metal reflector mounted above the lamp, having a vitreous enameled finish or which is treated in some other approved manner to give it a lasting, highly reflective surface. Sufficient light shall escape upward to illuminate the upper panels of the lantern. Along the open cuts the refractor shall be of the asymmetric type.

In the plaza light standards the bulbs shall be 1,000 watt capacity and in the one-light standards along the open cuts they shall be 500 watt. The total number of each type is listed in paragraph 196-14.

Along the open cut of the New York exit, the Contractor shall supply temporary lighting standards, as well as temporary lights. These standards shall be of steel piping,

three (3) inches in diameter, eight (8) feet six (6) inches high, fastened to the top of the concrete wall where directed. At the lamp locations two one (1) inch conduits have been brought from the concrete. The Contractor shall furnish at these points cast-iron, water-tight boxes with hinged covers housing a 2-pole, 30 ampere, 250 volt fused switch, mounted on a porcelain base and shall connect each box to the two existing conduits and to the light standard.

Traffic signals.

196-13. Located at the New York entrance and at the New Jersey entrance there shall be a traffic signal, of the color light type having two colors, red and green, mounted in the same horizontal plane. The signal shall be of the outdoor type with cast-iron box provided with gasketted covers. Bulbs shall be 100 watt, 110 volt. Back of the light shall be a parabolic silvered glass reflector. Lenses shall be of ten (10) inch diameter. At the New York entrance, the lenses shall be of the dispersive type that scatters the rays through a broad horizontal angle. Those in New Jersey shall be of the concentrating type that holds the rays to a parallel beam. The latter shall have a clear range of 1500 feet under bright sunlight conditions. The boxes shall be complete with mast and arm and all wiring. The wiring shall be No. 10 A. W. G., B. X. L. The mast shall be of such height as to hold the light fifteen (15) feet clear above the street. The arm shall be of such length as to hold the box ten (10) feet from the curb. The wiring of the signals shall be as directed.

Equipment to be furnished.

196-14. The equipment to be furnished and installed under this item of the contract comprises the following:

ITEM	Number Required	Shown on Drawing No.	Specified in Paragraph No.
15 kva transformers	8		
Section boxes	8		196-5
Lanterns, Type V, 1,000 watt	111	25	
" " W, 500 "	41	25	
Bracket lights, Type U, 500 watt	3	25	
Temporary standards, without lantern, with fuse and box	12		196-12
3-pole, 30 ampere fused switches	27		196-10
2-pole, 30 ampere fused switches	98		196-10
Traffic signals	2		196-13

WIRE AND CABLE

Size and Type	No. of Pieces	Total Length in feet
3—cond. No. 1/0, rubber, lead covered, 600 volt	9	3,000
3—cond. No. 4, rubber, lead covered, 600 volt	126	14,500
1—cond. No. 6, varnished cambric, lead covered, 3,000 volt	12	16,400
3—cond. No. 10, B.X.L., 600 volt	4	400
2—cond. No. 14, B.X.L., 600 volt	152	4,000

196-15 After installation the Contractor shall test all cables at 80% of the voltage specified herein for the factory test.

Payment, plaza lighting.

196-16. Payment for plaza lighting will be made at the lump sum price stipulated in Schedule Item 196, which price shall be in full compensation for furnishing all the material for, and installing, the plaza lighting in accordance with the drawings and as herein specified, complete, including the traffic signals specified in paragraph 196-13, and all expense in connection therewith or incidental thereto.

ITEM 197—TELEPHONE EQUIPMENT.

General.

197-1. The telephone system of the tunnel will consist of a complete operating system of the common battery, manually operated type, and shall include telephone instruments in the approaches and buildings, operating board, storage battery, battery charger, ringing equipment, telephones, cables, terminal boards at cable terminals, protective steel cabinet for cable terminals, telephone relays, extension bells, and everything else whether specifically enumerated or not, necessary for a complete modern telephone operating system unless otherwise specifically provided for. The Contractor shall also furnish a code call system to be installed in the buildings.

Telephones in tunnel.

197-2. The telephones in the tunnel proper will be provided and installed by the Commissions. Under this contract, the Contractor shall furnish and install cable connections therefor as directed herein and shall furnish and install extension relays for flashing the call light.

Call system.

197-3. The call for the tunnel telephones will consist of a light, to be supplied, mounted and wired under Item 195 of this contract. This shall be in addition to the bell which will be furnished by the Commissions as part of the telephone instrument.

Call light relay.

197-4. At each tunnel telephone location the Contractor shall furnish and install an extension relay for flashing the call light. The call light will be burning continuously. The relay shall be suitable for operation on

the telephone ringing circuit. When the ringing current is turned on the relay shall flash the call light with a slow movement. The relays must be protected against the dust and moisture and shall be mounted on the frame in the relay box specified in paragraph 201-45. Some of the relays will be located at a distance of two miles from the operating board and the relays must work satisfactorily at this distance through a circuit of No. 22 A. W. G. wire.

The lamp circuit is 110 volts, 60 cycle, not more than 50 watts.

Telephones in the buildings.

197-5. The various buildings will be subject to very damp conditions and the telephones to be installed therein shall be of the "mine" or "police" type. All parts shall be enclosed in a cast-iron box, all coils impregnated and all screws or other steel parts liable to rust shall be copper coated or treated by some other approved rust-resisting process. The box shall have a hinged cover with latch and handle. Cast on the cover in letters one and one-half (1½) inches high shall be the word "Telephone."

Extension bells.

197-6. With each of these instruments shall be furnished an extension bell and relay. The relay shall be suitable for operation on the telephone ringing circuit. It shall be entirely enclosed in a way to protect the parts from dust and dampness. The bell shall be a loud ringing bell operated from a 60 cycle, 110 volt source. Both bell and relay shall have form wound coils, impregnated to prevent damage from dampness.

Elevator telephones.

197-7. Mounted in each elevator shall be a telephone of the wall type. The windings of these shall be dampproof as specified for the other instruments.

Desk telephones.

197-8. The Contractor shall also furnish for use in the offices, telephones of the desk type. No extension bells will be required for these instruments.

Operating board.

197-9. The operating board shall be of the private branch exchange type, common battery, manual operation, for one hundred forty (140) lines. Mounted in the back of the board shall be the necessary relays.

Storage battery.

197-10. There shall be one storage battery of eleven cells of such capacity that when fully charged it shall be able to supply energy for 144 hours continuous operation of the board, with an average of 15 calls per line per day. The battery shall be mounted in a wooden cabinet to be furnished hereunder, the inside of which shall be heavily coated with an acid resisting paint.

The cells shall be of glass with a glass cover and set in a separate glass sand tray. With the battery shall be a spare cell, cover, five (5) separators, hydrometer and all necessary tools.

The battery shall be fully charged at the time of acceptance.

Battery charger.

197-11. There shall be one battery charging outfit of the mercury arc or bulb rectifier type. This shall be suitable for charging the battery while the latter is in service and no noises shall be audible therefrom over the telephone.

The charger shall be completed with all switching and protective equipment and with one spare bulb.

Ringing equipment.

197-12. The bell ringing equipment shall be driven by a 60 cycle, 110 volt A. C. motor. It shall have sufficient capacity to ring twenty (20) bells simultaneously. There shall also be supplied a hand operated ringing equipment for use in emergencies.

Code signal set.

197-13. The code calling set shall be suitable for calling twenty (20) individuals through a bell code. The set shall include gongs, relays for the operation of the gongs, timing device and operating board. The bells shall be loud ringing, single stroke gongs, suitable for oper-

ation in damp locations. A total of sixteen (16) bells will be required. The timing device shall send out impulses in proper order, automatically repeat a call a total of three times and then stop automatically. The timing device shall be automatic in action and shall not require any winding or clockwork. Code signals shall be sent by pressing a button corresponding to the number to be announced. The board shall be compact, easily mounted above the telephone board or in some other convenient position. The design shall permit easy extension to permit the installation of additional calls in the future if desired.

The equipment shall be suitable for transmitting the call over the No. 22 A. W. G. telephone wire specified in the succeeding paragraph.

Telephone cables.

197-14. The telephone cable will be used for the telephones, for the call signals, for the operation of switches and all incoming lines in the remote control system. The remote control system will be energized from a 120 volt, D. C. source. Cables shall be of the paper insulated type. In the tunnel the cable will be carried in three and one-half (3½) inch, square, tile ducts on the side opposite the sidewalk. In general, there are two such cables in each tunnel, a through cable running from shaft to shaft, without changes and without taps, and a service cable from which taps and loops are taken at each signal and telephone station. The cable shall conform to the requirements specified under Item 193.

Service cable taps.

197-15. The tap from the service cable across the tunnel to the relay box shall be rubber insulated, lead covered, ending in a terminal board in the relay box to be furnished under Item 201. As directed by the Engineer, certain of the wires in the service cable shall be teed to this tap cable and other wires shall be looped to it.

Building cables.

197-16. In the buildings the cable shall be drawn in four (4) inch steel ducts provided under another contract. The local wiring to the building telephones shall be installed under Item 197.

In the New York administration building, the wires from the operating board to the cable terminal specified in paragraph 197-18 shall be provided and installed under Item 197.

Vertical cable runs.

197-17. In the vertical runs the cable shall be supported by a steel messenger cable which in turn shall be supported in the building in an approved manner. This shall be attached to the telephone cable at frequent intervals by unwrapping a strand from the messenger, wrapping it about the telephone cable and soldering it thereto.

Cable terminals.

197-18. At each shaft, both at the control and at the tunnel level, all cables shall end in a cable terminal of the sealed type to prevent entrance of dampness into the cable. The same type of terminal shall be provided in the New York administration building and at any other place where the cable terminates. These terminals shall be fastened against the wall as shown on the drawings and the Contractor shall provide for them a steel cabinet with a roof and hinged doors which will protect the terminals from dirt and dampness. The steel in these cabinets shall be not less than one-eighth (1/8) inch thick.

The four cabinets in the control rooms shall have black marine finish. The general construction of the cabinets is shown on drawing No. 21.

Equipment required.

197-19. The principal items of equipment and the number of each to be provided for the telephone installation are as follows:

ITEM.	Number Required
Steel cabinets for protection of terminals	16
Mine or police type telephones for buildings	20
Wall type telephones	18
Desk type telephones	18
Extension relays for lights	43
Extension relays for bells	16
Alarm gongs for telephones	16
Bells for code calls	16
Telephone operating board	1
Code call operating board	1
Storage battery	1
Battery charger	1
Motor driven ringer	1
Cable terminals at shafts and in buildings, sufficient to provide terminals for all conductors.	
Wires and cables	See wiring schedule.

197-20. Included with the telephone equipment to be furnished hereunder, there shall be four telephone operator's headpieces, ten breast transmitters with head receivers, each equipped with a twenty (20) foot cord and plug for use with the plug receptacles installed on the switchboards to be furnished under Items 200 and 201, a chair and a complete set of original tracings on cloth showing all connections.

197-21. The schedule of telephone cable to be supplied hereunder is as follows: Cable schedule.

No. of Pairs	No. of Cables	Total Length in Feet	Total No. of Straight Joints	Total No. of Terminals	No. of Sections, Each Cable
		PAPER INSULATED			
440	2	4080	9	4	6
360	1	225	..	2	5
330	2	2730	7	4	5
240	2	6855	16	4	4
180	2	2645	6	4	3
100	4	1041	1	8	2
80	1	100	..	2	2
60	4	680	..	8	2
50	2	3995	10	4	2
40	2	745	..	1	1
30	2	745	..	1	1
25	7	2795	2	4	1
20	9	4387	2	4	1
15	12	5225	..	4	1
10	9	4415	3	5	1
5	3	1180	..	2	1
		RUBBER INSULATED			
1	51	766	..	..	1
5	62	1539	..	..	1
10	51	3780	..	..	1
15	1	60	..	..	1

In addition to the straight splices, there shall be 34 tee connections in cables of 40 pairs and less.

197-22. After installation the cables shall be subjected to a test pressure of 1000 volts and after the test, each cable shall have as many good wires as specified therefor. Tests.

197-23. Payment for telephone equipment will be made at the lump sum price stipulated in Schedule Item 197, which price shall be in full compensation for furnishing and installing the telephone equipment and code call system in accordance with the drawings and as herein specified, complete, and all expenses in connection therewith or incidental thereto except as otherwise provided for in paragraphs 197-2 and 197-3. Payment, telephone equipment.

ITEM 198—LIGHTING AND ELECTRIC HEATING FOR VENTILATION BUILDINGS AND SHAFTS.

198-1. The Contractor shall furnish and install a complete equipment for the lighting and electric heating of the four ventilation buildings and shafts. The energy for this equipment will be supplied from the 220/110 volt mains in each building through panel boards, whence the circuits shall be fed in two-wire branches. General.

198-2. Under other contracts, there will be supplied a complete conduit system with pull, junction and outlet boxes, buried in the concrete, also niches for the panel boards. Conduit system.

198-3. Under other items of this contract there shall be furnished the lighting transformers and the feed therefrom to the panel boards. Transformers.

198-4. Under this item, the Contractor shall furnish and install the panel boards, distribution cable and wire, the lighting units, plug receptacles, the fixed electric heaters in the river ventilation buildings and the portable electric heaters in the two land ventilation buildings. Scope of the work.

198-5. Niches for the panel boards and the conduits thereto provided under other contracts are steel lined. The Contractor shall furnish the panel boards with switches, fuses and covers. The cover shall be of enam- Panel boards, etc.

eled steel plate, one-eighth (⅛) inch thick, covering the entire niche and bearing therein two hinged doors, the outer door covering the switches and fuses and the central door covering the switches only. The outer door shall be provided with a lock; the central door with a spring catch and brass knob. On the inner side of the outer door shall be a steel partition which, when the door is closed, will entirely surround the switches and make it impossible, when the outer door is closed and the central door opened, to touch the fuses or other live parts. The general construction shall be as shown on drawing No. 28.

Fuses and switches.

Fuses shall be of the cartridge type. Switches shall be of the safety type, in which all live parts are covered. Each switch shall be separately removable.

The main switch on the board shall be a 3-pole, 100 ampere switch, without fuses, and the various circuits shall be provided with 2-pole 30 ampere fused switches connected between the neutral and an outer. The bus shall be not less than one-half (½) inch by one-sixteenth (1/16) inch copper. A nameplate shall be provided for each circuit and one for the cover. The number of circuits on each board shall be as called for hereinafter.

Fixed to the inside surface of the central door shall be a blueprint provided by the Engineer, showing the various circuits fed from the board.

Lighting fixtures.

198-6. The lighting fixtures shall be of the type shown on the drawings. R. L. M. dome reflectors shall be of the so-called glass steel type, which throw part of the light upward to the ceiling. The globe fixtures shall be of the opal type which has high diffusing and transmitting qualities.

In the storage battery room, units shall be of vapor-proof construction, and exposed metal parts of lighting units, plug receptacles, etc., shall be of aluminum or other acid resisting material.

Plug receptacles shall be of the type shown in the drawings. Outlet boxes for lights, push buttons and plug receptacles, etc., will be furnished under another contract and will be three and one-half (3½) inches square, subway type. Push buttons and other fittings to fit in these outlet boxes shall have a brass plate to cover the entire box opening. Plug receptacles, etc.

198-7. The heater circuits for the fixed heaters in the control rooms and lavatories in the river ventilation buildings shall be fed from panel boards in the room or in other convenient places, which in turn shall be fed from the switchboard as described above for the lighting circuits. The panel boards shall be as above described for the lighting panel boards except that the branches shall be 3 phase, 60 ampere, 220 volt and the main shall be 3 phase, 150 ampere, 220 volt. Heater circuits.

198-8. The material in the heaters shall be of special corrosion-resisting material, wound in a close spiral spring which in turn is coiled on a porcelain tube bearing a helical groove, which prevents adjacent coils touching. The various units so formed shall be mounted within a perforated enamel steel case which will permit free passage of air and prevent access to the live parts. On the fixed units for installation in the river ventilation buildings, the ends of the coils shall be covered with a steel housing having knockouts of sufficient size to permit making the connections therein. Fixed units shall be suitable for wall mounting. They shall have a capacity of 3,000 watts each, suitable for operation on a single phase, 220 volt circuit. Heater units.

Portable heaters shall be provided with a bail for convenience in carrying. They shall each have a capacity of 1200 watts and shall have an extension cord, suitably insulated for such service, fifty (50) feet in length and provided with a plug. Portable heaters.

Conduit connections.

Under other contracts, conduits and outlet boxes will be provided to a point in the wall back of the fixed heater. The Contractor shall provide a rigid conduit therefrom to the heater and a rigid conduit between the heater units, mounted together as shown on the drawings. He shall also install as part of the heater, a switch with two points for controlling the quantity of heat.

Connections to door bells.

198-9. Connections to the door bells, one in each of the four ventilation buildings, include push buttons installed on the door jambs and six (6) inch gongs with bell ringing transformers suitable for operation on 110 volt, 60 cycle current.

Exterior lights.

198-10. At each river building, the Contractor shall install, on the river side of the building, two bracket lights, Type U, with one hundred (100) feet of exposed one (1) inch conduit for the same, complete with junction and outlet boxes. The conduit for this purpose has been brought through the wall of the building and threaded and capped there. The Contractor shall supply the necessary junction boxes and support the conduit on the outside of the buildings. These lighting units and the wire are included in the equipment listed below.

Pull box door.

198-11. As part of the work under this contract, he shall supply a steel door for the pull box in the basement of the New York land ventilation building, as shown on drawing No. 28.

Equipment required.

198-12. The principal items of material and equipment and the number of each, required for the various ventilation buildings and shafts under this item, are as follows:

Item	Number Required			
	N. Y. Land Bldg.	N. Y. River Bldg.	N. J. River Bldg.	N. J. Land Bldg.
Lighting unit, Type A	132	67	73	83
Lighting unit, Type B	6	4	9	14
Lighting unit, Type C-6	13	21	36	28
Lighting unit, Type C-8	9	8	8	19
Lighting unit, Type D	75	54	51	72
Lighting unit, Type E	5	1	1	3
Lighting unit, Type F	46	51	45	24
Lighting unit, Type G	11	2	..	..
Lighting unit, Type H	19	10	12	48
Lighting unit, Type J	1	..	5	2
Lighting unit, Type U	..	2	2	..
Plug receptacle, Type L	80	62	53	85
Door bell	5	5	5	5
Double push button, Type M-1	38	30	40	40
Double push button, Type M-3	11	10	24	22
Double push button, Type N-1	6	..	..	6
Double push button, Type N-2	2	..	..	6
Double push button, Type M-4	..	..	..	1
Single push button, Type 0	..	2	2	1
Porcelain receptacle, Type P	19	22	24	26
Portable lamps, Type R	4	4	4	4
Light panel board, 4 circuit	5	4	4	3
Light panel board, 8 circuit	3	3	3	2
Heater panel board, 6 circuit	..	2	2	..
Heaters, fixed type	..	11	12	..
Heaters, portable type	6	6	6	6
Wire and cable.	See wiring schedule.			

Lighting units and fixtures are shown on drawing No. 25. Trim for panel boards is shown on drawing No. 28.

Wiring schedule.

198-13. The sizes of wire, the number of feet of each size of wire and the number of outlets required under this item in the various ventilation buildings are as follows:

Size of Wire	N. Y. Land Building Total Length in Ft.	N. Y. Land Building No. of Outlets	N. Y. River Building Total Length in Ft.	N. Y. River Building No. of Outlets	N. J. Land Building Total Length in Ft.	N. J. Land Building No. of Outlets	N. J. River Building Total Length in Ft.	N. J. River Building No. of Outlets
No. 10	1920	30	425	6	2675	46	870	12
12	21480	461	2160	38	13935	372	2200	48
14	3540	32	10830	291	1500	10	9840	235

All wire shall be rubber covered, weather-proof, and in most cases there will be only two wires per conduit.

Tests.

198-14. After installation the wires shall be subjected to a test pressure of 1250 volts. Wires which break down under this test shall be replaced.

Payment, building and shaft lighting and heating.

198-15. Payment for the lighting and electric heating of the ventilation buildings and shafts will be made at the lump sum price stipulated in Schedule Item 198 (a) for the land ventilation building and shafts, New York, or in Schedule Item 198 (b) for the river ventilation buildings and shafts, New York, or in Schedule Item 198 (c) for the land ventilation building and shafts, New Jersey, or in Schedule Item 198 (d) for the river ventilation building and shafts, New Jersey, which price shall be in full compensation for furnishing all the material for, and installing, the lighting and electric heating as shown on the drawings and as herein specified, complete, and all expense in connection therewith or incidental thereto.

ITEM 199—POWER AND CONTROL WIRING AND POWER AND LIGHTING TRANSFORMERS.

Scope of the work.

199-1. Under this item the Contractor shall furnish and install all power wiring required for the buildings and shafts, except the power wiring that has been installed under other contracts; the lighting wiring to the distribution panels to be furnished under Item 198; all control wiring except that included in the wires and cables for the telephones, and all power and lighting transformers, except the air blast transformers provided under another contract and to be installed under Item 206 of this contract and excepting the transformers for tunnel and plaza lighting to be furnished and installed by him under Items 195 and 196 of this contract.

Some of the work to be done under this item is shown on drawings Nos. 13 to 16 inclusive, 20 and 28.

Work done under other contracts.

199-2. Under another contract three 13,200 volt incoming power cables will be brought into each land ventilation building and connected to switch terminals there.

Under another contract 2,300 volt cables will be installed in the buildings, tunnels and plazas for distributing energy for power and lighting purposes and for the operation of pumps in the mid-river pump chamber. These cables terminate in the ventilation buildings, at potheads on the floor below the oil switches.

Under another contract air blast transformers will be delivered in each land ventilation building.

Work to be done under other items of this contract.

199-3. Under Items 195 and 196 of this contract, the Contractor shall furnish and install transformers at the shafts and plazas for tunnel and plaza lighting.

Under Item 197 of this contract, the Contractor shall furnish and install from the control floor of each building to the tunnel, and from the shafts to the New York administration building, telephone cables which will be used in part for control purposes.

Under Item 198 of this contract, the Contractor shall furnish equipment for lighting and heating in the ventilation buildings. This equipment includes the distribution panels, the lighting fixtures and the circuit wiring.

Work to be done under this item.

199-4. With the above noted exceptions, the Contractor shall furnish and install under this item of this contract, all 13,200 volt, 2,300 volt, 440 volt, 220 volt and 110 volt power wiring for the ventilation buildings and shafts and all wiring therein for control and indicating purposes and shall furnish and install all transformers in the ventilation buildings for power and lighting.

Conduits.

199-5. All wires shall be placed in conduit. These conduits with pull boxes and outlet boxes have been, or

will be installed, imbedded in concrete, under other contracts, except for certain slight exceptions as specified hereinafter where short lengths of conduit shall be furnished hereunder.

13,200 volt power cable.

199-6. The 13,200 volt power wiring shall be furnished and installed in each of the land ventilation buildings between the 13,200 volt oil switches and the transformers, provided under another contract, and to be installed under Item 206 of this contract. The sizes, insulation and lengths shall be as specified in the wiring schedule. Ends of all 13,200 volt cable shall be potheaded. Connections at the ends will be paid for under Item 206.

The number of runs and their aggregate lengths are as given in the wiring schedule forming paragraph 199-32 of this specification.

Potheads.

A total of thirty (30) potheads shall be supplied for these cables in each land ventilation building. Some of these potheads shall be mounted vertically and some of them horizontally.

Potheads shall be as specified under Item 193.

2,300 volt power cable.

199-7. The 2,300 volt power wiring shall be furnished and installed in each ventilation building. It shall include:

(a) Cables between the air blast transformers and the 2,300 volt oil switches, both of which have been furnished under other contracts but are to be installed under Item 206 of this contract.

(b) Cables between the 2,300 volt oil switches furnished under another contract but to be installed under Item 206 of this contract.

(c) Cables between the aforesaid oil switches and the 2,300 volt power and lighting transformers to be furnished and installed under this item.

(d) Cables between the aforesaid oil switches and the

2,300 volt fan motors to be furnished and installed under another contract. Included in this shall be the cables and connections to three 440 volt motors in each river ventilation building fed from transformers located near them, to be supplied hereunder. This wiring shall include primary and secondary connections.

The number of runs and their aggregate lengths are as given in the wiring schedule.

Two types of insulation are required for this service, 5,000 volt for cables covered in paragraph (a) and for some of those covered under paragraph (b) where special reliability is essential, and 3,000 volt insulation where the requirements are not so severe.

Connection of the above cables to the transformers and oil switches to be installed under Item 206 of this contract, will be made and paid for thereunder. Connections of the above cables to the transformers to be furnished under this contract and to the fan motors shall be made under this item.

Potheads shall not be furnished for these cables, but the lead shall be belled out one-quarter (¼) inch and the opening filled with compound.

440 volt power wiring.

199-8. The 440 volt power wiring shall be furnished and installed in each land ventilation building and to the pump room in each land shaft. It shall include:

(a) Cables between the air blast transformers to be installed under Item 206 of this contract and the 440 volt oil switches to be furnished and installed under Item 207 of this contract.

(b) Cables between the 2,300 volt oil insulated power transformers to be furnished and installed under this item at each land ventilation building and the 440 volt oil switches to be furnished and installed under Item 207 of this contract.

(c) Cables from the 440 volt oil switches to be fur-

nished under Item 207 of this contract and the pump motors in the pump rooms in each land shaft.

(d) Cables from the 440 volt oil switches to be furnished under Item 207 of this contract to the 440 volt fan motors to be furnished and installed under another contract.

(e) Connections from the air blast transformers to be installed under Item 206 of this contract to the motors driving the fans supplying the cooling air to the transformers.

(f) Connections from the 440 volt oil switches to be furnished under Item 207 of this contract, to the 460-230/-115 volt transformers to be furnished under this item.

The number of runs and their aggregate lengths are as given in the wiring schedule.

Connections.

The connections of the cables to the air blast transformers, covered in this section, shall be made under Item 206 of this contract, the connections of these cables to the 440 volt oil switches shall be made under Item 207 of this contract and the connections of these cables to the pump motors, fan motors and transformers to be furnished hereunder shall be made under this item.

The Engineer may forbid the installation of the 440 volt power cable specified under this section until after the delivery of the oil switches specified under Item 207.

Potheads shall not be furnished for these cables, but the lead shall be belled out one-quarter (¼) inch and the opening filled with compound.

Fan motors.

199-9. The fan motors to which connection shall be made as aforesaid comprise eighty-four (84) motors driving the tunnel ventilating fans and six (6) motors driving the fans supplying the cooling air to the air blast transformers.

Connection to ventilating fan motors.

199-10. The 84 motors driving the tunnel ventilating fans are wound rotor induction motors and the equipment which will be provided with them under another contract, includes:

Disconnecting switches for the primary windings.

Resistors for the secondaries.

Contactors for the resistors.

The disconnecting switch and the contactors are mounted on the same panel enclosed in a cabinet which is located on the same floor with, but not adjacent to, the motor. Connections between the contactors and resistors will be made under another contract. The work under this item shall include the cable from the oil switch to the disconnecting switch, connection from the disconnecting switch to the motor stator, from the motor rotor to the contactors and all connections at the motors and the panels.

It shall also include furnishing and installing two pieces of two (2) inch conduit at the panel for the primary connections from the oil switch to the disconnecting switch and from the disconnecting switch to the motor. These conduits shall be furnished and installed in the open as extensions of existing conduits imbedded in the floor or ceiling. They shall be brought into the cabinet through holes which have been drilled for that purpose and shall be fastened to the cabinet with lock nuts and bushed.

Because the existing conduits and the cabinets have been placed by different contractors, offsets will probably be necessary in the conduit specified in the preceding paragraph, which is to be furnished under this contract.

At the motors the rotor and stator leads have been brought out in conduit terminal boxes and the Contractor shall connect these with the conduits in the building with flexible conduit, one piece for the rotor and another for the stator.

The total number of feet of conduit required in the various ventilation buildings for this purpose is as follows:

Size and Type of Conduit.	Total Length in Feet. N. Y. Land Bldg.	N. Y. River Bldg.	N. J. River Bldg.	N. J. Land Bldg.
2 inch rigid	480	270	270	360
2 inch flexible	140	120	120	140

Transformers for 440 volt, ventilating fan motors.

199-11. Three of the motors driving the ventilating fans in each river ventilation building will be 440 volt motors driven from a 2,300 volt source. In addition to the cables to be furnished under this item, the Contractor shall furnish and install, as shown on the drawings, one 25 kva 2,200/440 volt 3 phase transformer for each motor as listed hereinafter and shall make all connections therefor.

This work of installation for these six motors shall include installing in connection with each motor, two G. E. current transformers, Type K 48, 40/5 amperes, which have been furnished under another contract. For each of these motor installations there are required two lengths of two (2) inch rigid conduit, one three (3) feet long and one five (5) feet long in addition to the conduit listed in paragraph 199-10.

Connections to transformer cooling fan motors.

199-12. In each land ventilation building, the three motors for driving the fans supplying the cooling air to the air blast transformers are squirrel cage motors and shall be connected directly to the 440 volt windings of the transformers through a 3-pole, single throw, 100 ampere, 500 volt, N. E. C. fused safety switch to be furnished under this item.

For each of these motors the work of installation requires two lengths of one and one-half (1½) inch rigid conduit, each averaging about ten (10) feet long, as shown

on drawings Nos. 13 and 14, and one length of one and one-half (1½) inch flexible conduit about five (5) feet long.

Connections to pump motors.

199-13. The motors driving the pumps at the eight shafts are squirrel cage, induction, 3 phase motors and have been furnished under another contract with all starting equipment and interconnections between the motors and starters. In each pump room the cables provided hereunder shall be connected to existing cables by means of terminals to be furnished under this contract. The Contractor shall also make a tee connection between the cables in each pump room and furnish the necessary terminals for this connection.

Conduit required for transformers.

199-14. Connections to the three 300 kva transformers in each land ventilation building include, in New Jersey, one four (4) foot length of two (2) inch conduit for each transformer and one six (6) foot length of three (3) inch conduit; and in New York, five (5) feet of two (2) inch conduit as shown on drawings Nos. 15 and 16.

The 100 kva transformers in the four ventilation buildings require a total of ten (10) feet of two (2) inch conduit, and four (4) feet of three (3) inch conduit as shown on drawings Nos. 15 and 16.

220 volt wiring.

199-15. The 220 volt and auxiliary wiring to be furnished and installed under this item includes:

(a) Connections from the 220 volt transformers to be furnished hereunder to the 220 volt distribution board to be furnished under Item 200.

(b) Connections from the distribution boards to the lighting and heating panels to be furnished under Item 198.

(c) Connections from the distribution boards to the elevator motors, to the air compressor motors, to the CO recorders, to the water heaters in the river ventilation buildings, to the pump motors in the river shafts, to the

small motors in the basement of the New York land ventilation building, to the plug receptacles to be furnished under this item, to the battery charging panels and the battery chargers and between the battery chargers and the batteries.

Connections to elevator and air compressor motors.

199-16. Connections to the four elevator and four air compressor motors include furnishing and installing a fused safety switch of 60 ampere, 500 volt capacity at each motor, a steel enclosed contactor with overload protection and two pieces, each five (5) feet long of one and one-half (1½) inch rigid or flexible conduit at each of the motors, two in each ventilation building.

Connections to CO recorders.

199-17. Connections to the CO recorders include five (5) feet of one and one-half (1½) inch rigid or flexible conduit and a fused safety switch at each of the four recorders. Conduit is also necessary for the control wire as specified hereinafter.

Connections to water heaters.

199-18. Connections to the water heaters include five (5) feet of one and one-half (1½) inch rigid or flexible conduit and a fused safety switch at each of the two heaters.

Connections to sump and pump motors.

199-19. Connections to the pump motors include connecting the cable to existing cables and making two tee connections between 3-conductor cables in each of the river shaft pump rooms.

Connections to pump and ash hoist motors.

199-20. Connections to the three pump motors and to the ash hoist motor in the New York land ventilation building include furnishing and installing about fifteen (15) feet of one and one-half (1½) inch rigid conduit, five (5) feet of one (1) inch flexible conduit, one 3-pole, 30 ampere, fused safety switch and one condulet 3-pole plug and receptacle.

Connections to the battery chargers.

199-21. Connections to the eight battery chargers include one and one-half (1½) inch rigid conduit at connections from the motor and generator terminals to the conduit in the floor.

199-22. Connections to the plug receptacles include furnishing and installing covers to the existing boxes and furnishing and installing fuses and 250 volt, 30 ampere receptacles. Receptacles required.

The number of receptacles to be furnished and installed in the various ventilation buildings is as follows:

New York land ventilation building. .10 receptacles
New York river ventilation building. . 7 receptacles
New Jersey river ventilation building. 6 receptacles
New Jersey land ventilation building. 8 receptacles

These shall be in accordance with drawing No. 25, Mark K.

199-23. The control cable to be provided hereunder includes generally the following: Control cable.

The D. C. control wire, including the leads to the D. C. board. This does not include the wire and connections for the D. C. lights.

The A. C. control wire fed from the distributing transformers to be furnished by the Contractor under Item 207 of this contract.

The A. C. indicating and control wires fed from the current and potential transformers to be furnished under this and other contracts.

The work under this item includes connecting the wires to equipment which will be furnished and installed under other contracts. Connections to equipment to be installed under other items of this contract shall be made under such items.

In addition to the wires and cables as given in the wiring schedule, the Contractor shall furnish the following equipment.

199-24. In each of the four ventilation buildings there shall be furnished and installed three panel boards controlling the D. C. circuits. These shall be mounted in steel lined niches which will be furnished under another Panel boards.

contract. These niches shall be provided with a steel cover of enameled plate not less than one-eighth (⅛) inch thick, supplied with a hinged door to cover the switches and fuses. This door shall have a knob and a latch, as shown on drawing No. 28. Fuses shall be of the cartridge type. Switches shall be of the blade or lever type, 30 ampere, 125 volt. Feed to the board shall be through two lugs. A main switch is not called for.

In the two land ventilation buildings the boards shall have twenty-two (22) circuits each. In the two river ventilation buildings the boards shall have twelve (12) circuits each.

Conduits at starting cabinets.

199-25. At some of the eighty-four (84) starting cabinets for the fan motors, the Contractor shall extend the existing one and one-half (1½) inch conduits from the ceiling and shall terminate the same six (6) feet inside the cabinets.

These cabinets will be completely wired to terminals near the base. The Contractor shall, under this item, connect the control and indicating wires to these terminal boards.

The conduit to be furnished and installed at the starting cabinets in the various ventilation buildings is as follows:

Location	No. of pieces	Total length in feet
New York land ventilation building.....	54	980
New York river ventilation building.....	6	108
New Jersey river ventilation building....	6	108
New Jersey land ventilation building....	12	216

Conduits at local control stations.

199-26. Near each of the eighty-four (84) fan motors the Contractor shall extend two existing one and one-half (1½) inch conduits and shall terminate the same in a local control station to be provided under Item 200 of this contract.

The conduit to be furnished and installed at the local control stations in the various ventilation buildings is as follows:

Location	Total Length in Feet.
New York land ventilation building	480
New York river ventilation building	150
New Jersey river ventilation building.....	150
New Jersey land ventilation building	200

Push button box.

199-27. At each of the eighty-four (84) damper motors, the Contractor shall furnish and install a push button box with two buttons. The buttons shall be of the industrial control type, spring return and when pressed shall break one circuit and shall make one circuit. The box shall be of cast iron and shall have, near the two buttons, the words "Open" and "Close." Wires shall be brought in at the back. The box shall be fastened to and be an extension of a 3½ inch by 3½ inch cast-iron outlet box of the subway type to be provided under another contract.

Transformer control cable.

199-28. At each of the three air blast transformer banks in the New York land ventilation building, he shall drill and bush holes in the covers of outlet boxes for the control cable as shown on drawings Nos. 13 and 14.

In the New Jersey land ventilation building, he shall bush the conduits at each bank of transformers, but no drilling is required.

Conduit at CO recorders.

199-29. At the CO recorders in each of the four ventilation buildings he shall extend an existing one and one-half (1½) inch conduit five (5) feet.

Transformers required.

199-30. The transformers to be furnished and installed in the various ventilation buildings are as follows:

New York land ventilation building: Three 300 kva 3 phase 2300-460 volts, two 100 kva 3 phase 460-230/115 volts.

New York river ventilation building: Two 100 kva 3 phase 2300-230/115 volts, three 25 kva 3 phase 2300-460 volts.

New Jersey river ventilation building: Two 100 kva 3 phase 2300-230/115 volts, three 25 kva 3 phase 2300-460 volts.

New Jersey land ventilation buildings: Three 300 kva 3 phase 2300-460 volts, two 100 kva 3 phase 460-230/115 volts.

These shall be oil insulated, self cooled, 3 phase, 60 cycle. The 300 kva transformers shall each have four 2½% voltage taps below normal. Mountings shall be as shown on drawings Nos. 15 and 16. He shall ground each case to an existing ground cable brought out of the floor adjacent to the transformer.

Partitions in pull boxes.

199-31. In the New York land ventilation building, he shall provide steel partitions in six pull boxes as shown on the drawings and in the New York river ventilation building, he shall provide partitions in five such boxes as shown on drawing No. 28.

Wiring required.

199-32. The sizes, number of pieces and total length of each kind of wire to be installed is shown in the following schedule. The particular connections to be made will be specified by the Engineer.

POWER CABLE.

Size, insulation and voltage	N. Y. Land Building No. of Pieces	N. Y. Land Building Total Length in Feet	N. Y. River Building No. of Pieces	N. Y. River Building Total Length in Feet	N. J. Land Building No. of Pieces	N. J. Land Building Total Length in Feet	N. J. River Building No. of Pieces	N. J. River Building Total Length in Feet
Single Conductor 1,250,000 C. M. V. C., F. P., 5000 volt	9	75	12	120	12	120	12	120
Single Conductor 800,000 C. M. V. C., L., 3000 volt	18	1485	..	...	18	1830	..	...
Single Conductor 800,000 C. M. V. C., F. P., 3000 volt	9	105	..	...	9	105	..	...
3-Conductor 600,000 C. M. V. C., L., 600 volt	3	205	..	...	3	195	..	...
Single Conductor 500,000 C. M. V. C., L., 17,000 volt	6	120	..	...	6	150	..	...
Single Conductor 500,000 C. M. V. C., L., 5,000 volt	18	1035	42	1110	18	990	18	465
Single Conductor 4/0 V. C., L., 17,000 volt	9	645	..	...	9	225	..	...
Single Conductor 3/0 V. C., L., 5,000 volt	6	390	..	...	6	360	..	...
3-Conductor 2/0 V. C., F. P., 600 volt	..	...	6	270	6	130	6	220
3-Conductor 2/0 V. C., L., 600 volt	14	1575	..	...	20	1580	..	...
Single Conductor 2/0 R. W., P., 600 volt	24	1680	24	3300	24	1800	24	1900
3-Conductor 1/0 V. C., L., 3000 volt	3	250	..	...	3	180	..	...
3-Conductor 1/0 V. C., F. P., 600 volt	6	225	6	170	..	...	7	215
Single Conductor 1/0 R. L., 600 volt	2	90	2	130	2	60	2	130
3-Conductor No. 2 V. C., L., 3000 volt	48	3380	41	2575	48	3260	41	2595
3-Conductor No. 2 V. C., L., 600 volt	10	875	9	515	7	410	9	760
3-Conductor No. 2 V. C., F. P., 600 volt	3	105	3	120	6	165	3	120
3-Conductor No. 2 R., W. P., 600 volt	11	485	13	520	15	670	15	555
2-Conductor No. 2 V. C., L., 600 volt	13	455	10	615	13	550	6	275
Single Conductor No. 2 V. C., L., 5,000 volt	9	225	27	810	9	270	27	675
Single Conductor No. 2 R., W. P., 600 volt	..	...	..	...	3	145	..	...
3-Conductor No. 4 V. C., L., 3,000 volt	3	75	2	65	3	60	..	...
3-Conductor No. 4 V. C., L., 600 volt	2	80	2	40	2	80	2	60
3-Conductor No. 4 V. C., F. P., 600 volt	15	500	3	90	12	310	3	90

Single Conductor No. 4 R., W. P., 600 volt	4	100	4	100	4	100	4	80
3-Conductor No. 6 R., W. P., 600 volt	2	140	..	...	3	85	..	...
3-Conductor No. 6 V. C., L., 600 volt	2	65	2	35	2	45	2	40
Single Conductor No. 8 R., W. P., 600 volt	10	1475	2	50	2	50	2	40

The various abbreviations used above refer to the following:

C. M., circular mils.
V. C., varnished cambric.
F. P., flameproof.
L., lead covered.
R., rubber covered.
W. P., weather proof.
All number sizes refer to A. W. G.

CONTROL CABLE.

Size,	N. Y. Land Building No. of Pieces	N. Y. Land Building Total Length in Feet	N. Y. River Building No. of Pieces	N. Y. River Building Total Length in Feet	N. J. Land Building No. of Pieces	N. J. Land Building Total Length in Feet	N. J. River Building No. of Pieces	N. J. River Building Total Length in Feet
14 Conductor 19/25	80	2400	20	830	80	2820	20	710
14 Conductor 3 of 19/22, 11 of 19/25	26	1355	27	1080	27	840	27	980
12 Conductor 19/25	27	2700	21	2010	28	3310	21	1975
12 Conductor 6 of 19/22, 6 of 19/25	156	8300	131	6520	156	8010	138	6850
10 Conductor 19/22	2	185	2	110	2	125	2	110
10 Conductor 19/25	52	1840	31	1510	56	2640	25	905
6 Conductor 19/25	58	1360	48	650	60	1090	51	940
6 Conductor 3 of 19/22, 3 of 19/25	3	150	..	...	..	...	..	...
4 Conductor 19/22	57	2725	28	2055	68	3525	37	2235
3 Conductor 19/22	23	530	18	185	24	515	22	555
3 Conductor 19/25	44	1125	26	615	42	1345	23	415
2 Conductor 19/22	152	1870	77	1114	154	1935	69	924
2 Conductor 19/25	6	60	..	...	9	120	..	...

Tests.

199-33. At the factory cables shall be tested in accordance with the standard requirements of the American Institute of Electrical Engineers. After installation cables shall be given a high potential test at 80% of the voltage specified for the factory test. Any length that fails under this test shall be replaced. Patching will not be permitted. Joints shall be inspected before being taped.

One of each size of transformers shall be tested in the presence of the Engineer as per the Standards of the Power Club.

Payment, power and control wiring and transformers.

199-34. Payment for power and control wiring and power and lighting transformers in the various ventilation buildings will be made at the lump sum price stipulated in Schedule Item 199 (a) for the land ventilation building, New York, or in Schedule Item 199 (b) for the river ventilation building, New York, or in Schedule Item 199 (c) for the land ventilation building, New Jersey, or in Schedule Item 199 (d) for the river ventilation building, New Jersey, which price shall be in full compensation for furnishing all the material for, and installing, the power and control wiring and power and lighting transformers in accordance with the drawings and as herein specified, complete, and all expense in connection therewith or incidental thereto including conduit work required.

ITEM 200—CONTROL BOARDS, STORAGE BATTERIES AND CONCRETE FLOORING.

Scope of the work.

200-1. Under this item the Contractor shall provide and install:

Four (4) control boards, one in each ventilation building, for the control of the oil switches and motors located therein.

Four (4) relay boards, one in each ventilation building, carrying the relays for the protection of the various circuits.

Four (4) distribution boards for the 220 volt A. C. and 125 volt D. C. distribution, one in each ventilation building.

Four (4) storage batteries, one in each ventilation building, each with two (2) motor-generator battery chargers. The panels for controlling the batteries and chargers shall be part of the distribution boards.

Eighty-four (84) local motor control boards.

Concrete floor finish for two or more rooms in each building as shown on the drawings.

Miscellaneous steel protection.

The work to be done under this item is shown on drawings Nos. 4 to 9 inclusive, 11 and 20.

Control board.

200-2. The control board to be installed in each ventilation building shall consist of steel cabinets fastened alongside each other, the front faces of the cabinets forming the adjacent panels of the board. Doors shall be provided in the back to permit access to interior connections. Relays shall be mounted on the doors.

Conduits.

200-3. Under other contracts conduits will be placed in the floor terminating in pits above which the control and relay boards will be located. The dimensions of the boards shall be as shown on the drawings to fit the conduit layout. Slight variations from these dimensions will be permissible.

Control board cabinets.

200-4. Each cabinet shall be well braced and closed on the front, top, back and sides. The bottom shall be open to permit bringing in thereby the cables for indicating and control purposes. The housing shall be rigid and thoroughly squared to insure that when adjacent housings are mounted together the sides will fit without interstices. The sides and tops shall be of steel not less than one-sixteenth (1/16) inch thick. The fronts and backs shall be of steel not less than one-eighth (⅛) inch thick and shall be smooth, without blisters, waves, wrinkles or other blemishes that will detract from their appearance. Ventilation holes shall be provided in the backs near the top and bottom screened with fine copper mesh to prevent entrance of dirt.

Doors shall be flush with sunken hinges and shall fit tightly to prevent entrance of dirt to the interior. Each door shall be provided with a latch, knob and lock and with a stop for the open position. Doors and hinges shall be strongly built to carry the relays mounted on the doors and to prevent vibration.

Bolt holes shall be provided in the floor and side walls of the cabinets for holding them together and to the floor of the building.

All steel shall be enamelled on the inside and have black marine finish on the outside.

There shall be a base board around the cabinets and an ornamental cornice. There shall be narrow vertical mouldings covering the front and back joints between adjacent cabinets and finishing the corners of the end cabinets.

Wiring in cabinets.

200-5. All wires within the cabinets shall be arranged along the walls in a neat workmanlike manner. Cabinets shall be completely wired at the factory. Wires shall be rubber or varnished cambric insulated with flame-proof braid. The size shall be not smaller than No. 12 A. W. G. The wiring shall be supported with cleats. These cleats shall have rounded edges and all precautions shall be taken not to injure the insulation. Wiring of relays mounted on the doors shall be by means of extra flexible cable. All wires shall be brought to suitable terminal boards at the bottom of the cabinet. These boards shall be of moulded material and of a design suitable for bringing thereto the wires from the control and indicating circuits from the apparatus controlled. They shall be constructed with insulating partitions between adjacent terminals and each terminal shall be equipped with two (2) screws, one for the wire in the cabinet and one for the incoming wires. Half of these terminals shall have a disconnecting switch incorporated in the terminal board.

The terminal boards shall be provided with covers and shall be similar to those manufactured by the Burke Electric Company or approved equal.

Face of control board.

200-6. The face of the control board shall be of the miniature bus type, as shown on drawings Nos. 8 and 9. There shall be two busses, one representing the New York feed and the other representing the New Jersey feed. The drawings show the boards in the New York land and river ventilation buildings. The board in the New Jersey land ventilation building is similar to that in the New York land ventilation building, but the switches for the incoming cables shall be on an extension of the lower bus instead of the upper and there will be similar changes in two other panels.

The board in the New Jersey river ventilation building shall be identical with the board in the New York river ventilation building except that one pair of switches on one panel with indicating lights and with instruments will be omitted.

Miniature bus bars shall be of brass or copper approximately one-half (½) inch by one-sixteenth (1/16) inch. The upper bus shall have a bright brass or copper finish and the lower shall be nickel-plated. The finish shall be such as to prevent corrosion or discoloration.

The mimic disconnecting switch shall be hinged and permit opening to represent the actual position of the switch.

Instruments, switches, etc.

200-7. The instruments, switches, etc., to be mounted on the board shall comply with the requirements hereinafter specified.

Relay board.

200-8. The cabinets forming the relay board shall be constructed and assembled similarly to those forming the control board.

Multi-control relays.

200-9. In addition to the relays installed on the control and relay boards the Contractor shall furnish and install multi-contact relays on the motor starting panels and automatic throw-over equipment mounted above the

boards furnished under another contract for damper operation.

There shall be a total of eighty-four (84) multi-contact relays, twenty-four (24) in each land ventilation building and eighteen (18) in each river ventilation building, complying with the requirements specified in paragraph 200-48. The Contractor shall install the relays on a one (1) inch ebony asbestos panel eleven and one-half (11½) inches by thirty (30) inches, beveled, to be furnished under this contract and shall install all necessary wiring and terminal boards.

In each of the four ventilation buildings, the Contractor shall furnish two 75 ampere, 3-pole contactors mounted on the same panel, interlocked electrically and mechanically, to throw over the damper load in case of failure of the normal supply and to reconnect it on return of voltage. He shall supply all contacts and relays to effect this operation.

This equipment shall be mounted above a slate board of three (3) panels, each thirty (30) inches wide. The Contractor shall furnish a total of three (3) panels in each ventilation building so as to carry out the lines of the board, on one or more of which three panels he shall mount the throw-over equipment.

Pipe frames for this slate board will be furnished under another contract. Clamps and wiring for the panels specified hereunder shall be furnished under this contract.

Sills for cabinets.

200-10. As shown on the drawings the control and relay panels shall be located above pits in the floors. The Contractor shall build up the concrete floor in the pit, shall provide dividing concrete walls therein and shall furnish one hundred fifty (150) feet of one and one-half (1½) inch steel conduit in the floor concrete. He shall furnish and fasten to one side of the pit as shown, a two (2) inch by one-quarter (¼) inch copper bar, connected to ground cables brought out from the concrete under another contract.

As a sill for the cabinets, the Contractor shall provide and imbed in the floor finish to be laid by him under this item, two angles or channels. These shall be drilled for the bolts holding the cabinets in position and shall be accurately levelled and laid to template. They shall be provided with suitable anchors to hold them in the concrete.

He shall deck over the space between the boards with one (1) inch asbestos lumber suitably carried on steel supports. The asbestos lumber shall comply with the requirements specified under item 112 and shall be given three coats of approved paint, matching in color the concrete floor finish.

The ground bus, concrete floor and partitions, conduit laid in floor, asbestos flooring, supporting steel and all work of installation and connection will be paid for under this item.

Erection.

200-11. The Contractor shall locate the cabinets in position, bolt them to the sills, install all outside finish and shall connect to the appropriate terminals, the various control wires to be installed by him under Item 199 of this contract.

The Contractor shall ground all steel work and connect all circuits to be grounded to the ground busses in the pit.

Distribution boards.

200-12. The four (4) distribution boards, one of which shall be installed in each ventilation building, will comprise panels for three purposes, 220/110 volt A. C. distribution, 125 volt D. C. distribution and battery control. The general appearance shall be as shown on drawing No. 11.

Panels and bases.

200-13. The panels shall be of steel one-eighth (⅛) inch thick with black marine finish.

As shown on the drawings, boards shall be of the dead front safety type. Each switch shall be fused and shall be mounted on a separate, easily detachable panel, with a subsidiary panel or door thereon, permitting access to the

fuses, but so interlocked with the switch that access to the fuses will be possible only when the switch is open.

The form of switch handle shown on the drawing is not essential, but indicates an acceptable type.

Battery panel.

200-14. The battery panel shall be suitable for the control of the two motor-generator charging sets and the battery. It shall carry 3-pole motor switches, 3-pole contactors for motors, temperature relays for motors, 2-pole contactors for generators, 2-pole switches for generators, ammeters, voltmeters, potential receptables, fuses and all other necessary equipment. Switches shall be of the fused, safety type. Contactors shall be mounted on a slate panel on the back of the board.

On failure of A. C. voltage, the sets shall automatically be disconnected on both the A. C. and D. C. sides and shall be reconnected on resumption of A. C. voltage.

Distribution board.

200-15. The distribution board shall be mounted on a steel sill supplied and imbedded in the floor by the Contractor. This shall be accurately drilled and tapped for the bolts holding the switchboard in position. Suitable anchors shall be supplied to hold the sill securely in the concrete.

The Contractor shall furnish and install the braces to support the board from the wall. At the ends of the boards he shall furnish hinged doors to give access to the space back of the board. These doors shall be of steel frames, enclosing steel mesh and each shall be provided with a knob, latch and lock.

In a building where the board is in separated sections, a door shall be furnished at each end of each section.

Storage battery.

200-16. In the four ventilation buildings, each of the storage batteries for oil switch control shall be of the lead plate type, with 60 cells. It shall have a capacity of 50 amperes for 8 hours, 200 amperes for 1 hour and 500 amperes for 1 minute with a final voltage per cell of not less than 1.75 in each case. Each battery equipment

shall be complete with racks, two (2) battery charger motor-generator sets, switch panel, distribution board and all interconnections. The battery shall be fully charged when it is accepted.

Battery cells.

200-17. Battery cells shall be of glass, each complete with positive and negative plates, separators, glass holding bolts and electrolyte. Cells shall be set in glass trays on a sand cushion. Numbered lead tablets shall be provided, one for each cell.

Connections between cells.

200-18. Connections between cells shall be of double lead straps, each one and five-sixteenths (1 5/16) inches by five-sixteenths (5/16) inch. Where cells are not contiguous, connections shall be of rubber insulated copper cable, 4/0 section, supported in an approved manner.

Cell mountings.

200-19. Cells shall be mounted in a rack of yellow pine, of two and three-quarters (2¾) inch by three and three-quarters (3¾) inch timbers bolted together. Uprights shall be not more than five (5) feet apart. Racks shall rest on vitrified brick, cemented in position. The rack and all other wood or iron work in the battery room shall be protected with two coats of approved acid resisting paint.

Battery charger.

200-20. The battery charger shall consist of a motor driven generator, both on the same bedplate.

Motor.

200-21. The motor shall be 220 volt, 60 cycle, 3 phase, squirrel cage, suitable for starting without compensator or starting resistance and of such capacity that it can run continuously while the generator is delivering its full normal load as specified herein, with a temperature rise not exceeding 40° C. and of such overload capacity that it can supply the overload specified without falling out of step.

Generator.

200-22. The generator shall be designed for trickle charge. It shall be able to deliver a load of 60 amperes at 140 volts continuously with a temperature rise not to exceed 40° C. The magnetic characteristics shall be such

that at 140 volts, 60 amperes, it will be so saturated, that the charging current will be automatically reduced with increase of battery charge. At the low charging voltage the field shall be sufficiently saturated to insure close regulation. For normal operation it shall be shunt wound. The field rheostat shall insure close voltage adjustment at all loads between 125 and 140 volts. In time of emergency the generator may be used to operate the oil switches. For these conditions the machine must be able to supply an instantaneous load of 105 amperes without destructive sparking or heating. The magnetic characteristics shall be such that if the voltage at 60 amperes is 129, the voltage at 105 amperes without adjusting the rheostat shall be not less than 105 volts. To obtain these conditions a compound winding is permissible which will be cut out during normal operation. The switch controlling the series winding may be mounted on the charger.

Local control boards.

200-23. The eighty-four (84) local control boards for the fan motors shall be cast-iron boxes with the control equipment mounted therein. The box shall have a hinged cast-iron cover equipped with a latch. There shall be twenty-four (24) such boards in each land ventilation building and eighteen (18) in each river ventilation building.

The control equipment mounted in the box shall consist of a control switch similar to the oil switch control switches on the control boards, key operated transfer switch, emergency stop button, damper cutout button and speed control switch. It will be possible to control a pair of motors from the control board or from either one of two local control stations and the lock for the transfer switch of the two boxes shall be fitted by the key normally inserted in the key operated transfer switch on the control board.

Steel mesh enclosure.

200-24. In each of the four ventilation buildings, under another contract, there will be furnished and installed, a board, 90 inches wide, carrying the contactors for con-

trolling the damper motors. The Contractor shall enclose this board in a framework of steel mesh provided with three doors, the frame of each being equipped with a knob, latch and key. There shall also be doors giving access to the space back of the board.

Control and power wiring.

200-25. The Contractor, under this item, shall connect to the various boards and control stations to be furnished and installed hereunder, the control and power wiring to be installed by him under Item 199 of this contract.

Ground testing equipment.

200-26. In each oil-switch room, 13,200 volt room, 2,300 volt room and 440 volt room, the Contractor shall supply ground testing devices and ground testing cables.

The devices shall be sufficient in number and in such locations that not more than fifty (50) feet of cable will be necessary to connect the busses at any oil switch, to the ground testing device.

He shall furnish in the New Jersey land ventilation building three such cables, each fifty (50) feet long, and in each of the other buildings two such cables. The cables shall be No. 2 A. W. G., extra flexible, rubber insulated for 25,000 volts and braided. The design shall be subject to approval.

In each ventilation building he shall furnish six cables of 2/0 A. W. G., extra flexible cable, rubber insulated for 25,000 volts, one end to be provided with a single clamp for fastening to the ground bus in the 13,000 volt, 2,300 volt and 440 volt housings, and the other end to be provided with three branches which can be clamped to the three busses.

The ground bus of the 2,300 volt switch is bolted directly to the steel work of the switch housing and, if necessary, the Contractor shall provide terminals at each switch housing for fastening the ground cable thereto.

Concrete floor finish.

200-27. In the main control rooms, the supervisory control rooms and the 220 volt control rooms of the various ventilation buildings, as shown on the drawings, the floors will be left unfinished to enable the Contractor to place the bolting down sills previously referred to.

After these sills are set in position, the floor shall be covered with approximately three (3) inches of concrete with a mortar top coat and finished off to a smooth sidewalk finish, all as specified under Item 27. The areas to be finished in these rooms may be scaled from drawings Nos. 4 to 7 inclusive.

Name plates.

200-28. The Contractor shall furnish a complete set of name plates and other approved distinguishing devices for the apparatus. Each panel and each control switch and relay shall bear a name plate of brass or other approved material. Fuses and terminals shall be numbered as directed.

Instruments.

200-29. The instruments to be furnished under this item shall comply with the following requirements:

SWITCHBOARD INSTRUMENTS.

Oil circuit breaker control switch.

200-30. All switches for the control of the oil circuit breakers shall be identical. For the operation of the closing and tripping circuits, the switch shall be provided with a single-pole, double-throw, normally open, contact arrangement. In addition to the closing and tripping contacts, there shall be four normally closed auxiliary contacts, three of which will be closed and the other opened by the closing operation and vice versa. The handle shall be of a shape or shall bear a metal insert or a ridge, representing an extension of the bus. The design shall be such, that the closing circuit or the tripping circuit cannot be closed without causing the handle to automatically lock in the position indicating the operation performed, and causing the proper condition of auxiliary contacts. All contacts shall be capable of carrying 100

amperes for one-half (½) second and shall be able to interrupt the circuit to which they are applied at least 50,000 times at two-minute intervals.

Each switch shall have an engraved name plate.

Contacts shall be so designed that their resiliency cannot be affected by heating due to excessive current, poor contact or by arcing at contacts.

Motor speed switch.

200-31. On each of the fourteen (14) motor panels there shall be a motor speed switch. This switch shall consist of a set of three independent switches with a single handle for the three. Each of these shall be a two-position switch making one circuit in the "on" position and breaking this circuit in the "off" position. It shall be impossible to remove the handle unless the switch is in the "off" position. All contacts shall be capable of carrying 100 amperes for one-half (½) second and shall be able to interrupt the circuits to which they are applied at least 50,000 times at two-minute intervals. Contacts shall be so designed that their resiliency cannot be affected by heating due to excessive current, poor contact or by arcing at contacts.

Supervisory transfer switch.

200-32. The supervisory transfer switch shall be a two-position switch, the electric connections being such that it will serve as an 8-pole, double-throw, heel and toe switch. The switch shall have a star wheel or other device which will prevent its remaining in any other than the two desired positions. All contacts shall be capable of carrying 100 amperes for one-half (½) second and shall be able to interrupt the circuits to which they are applied at least 50,000 times at two-minute intervals. Contacts shall be so designed that their resiliency cannot be affected by heating due to excessive current, poor contact or by arcing at contacts.

Key transfer switch.

200-33. Adjacent to the oil circuit breaker control switch for the motor (twelve [12] in each land ventilation building and nine [9] in each river ventilation building), there shall be one key operated transfer switch. The

lock operated by the key shall be of the tumbler type and shall be subject to the same master key as the lock being supplied by the B. F. Sturtevant Company under Contract No. 12 for locking disconnecting switches for ventilating fan motors. The face shall have a black marine finish and the barrel shall be nickel plated. It shall act as an 8-pole, double-throw switch. The switch shall have a star wheel or other device by which each position is clearly identified. The construction shall be such that the key can be withdrawn from the lock only when it is in one of the two positions and not when it is in the other. All contactors shall be capable of carrying 100 amperes for one-half (½) second and shall be able to interrupt the circuits to which they are applied at least 50,000 times at two-minute intervals. Contacts shall be so designed that their resiliency cannot be affected by heating due to excessive current, poor contact or by arcing at contacts.

Lights.

200-34. The lights shall be suitable for operation at from 120 to 140 volts. Each unit shall consist of a low voltage Mazda lamp, a receptacle, resistor, and a color cap. For use with green color caps, resistors shall be of a value giving nominal rated voltage at the lamp with a life of over 1,500 hours at 140 volts and satisfactory visibility at 120 volts. For use with clear color caps, two values of resistance shall be provided for each lamp permitting operation at "bright" (approximately 133% nominal voltage) or "dim" (approximately 60% nominal voltage). Bright life of lamp when operated shall be at least 500 hours. Oil circuit breaker lamps shall burn in series with the trip coil.

Ammeters, voltmeters, etc.

200-35. Ammeters and voltmeters shall be of the flush type, approximately four (4) inches in diameter. Certain of these shall be suitable for current transformers with 10 ampere secondaries, others with 5 ampere secondaries, others with one ampere secondaries. Temperature indicators shall be of the flush type. By means of transfer plugs, it shall be possible to read the temperature of nine

(9) different transformers, there being a temperature coil embedded in each transformer.

Instruments on local control board.

200-36. On each local control board (twenty-four [24] in each land ventilation building and eighteen [18] in each river ventilation building), there shall be mounted the following:

One spring return industrial control push button, mounted in a cast-iron box with a holding coil to hold the circuit open when energized. The coil shall be for from 120 to 140 volts, D. C. When depressed, the button shall break one circuit.

One industrial control push button in a cast-iron box which shall make one circuit when depressed.

One oil circuit breaker control switch and pilot light identical with those specified for the main control board.

One key operated transfer switch, a duplicate of the key operated transfer switch on the main control board.

One motor speed switch, to be similar to the switch specified in paragraph 200-31, except that each single switch shall make and break two circuits instead of one.

Interlocks.

200-37. The interlocks called for between switches shall consist of contactors, solenoids or motor driven switches, mechanically interlocked with each other and controlling the closing and tripping circuits of the oil circuit breakers. The operating voltage shall be from 120 to 140 volts, D. C. Moving of interlocking parts shall be effected only by applying the operating power and the design shall be such that there shall be no tendency, due to the weight, or mass, or friction of the interlocking parts, to delay the opening of an oil switch on account of relay action or control switch operation. Three types of interlocks are called for.

The eight-switch interlock shall be suitable for interlocking the eight switches on one of the 2,300 volt busses in each land ventilation building. In these buildings the

three power transformers each feed a cable through an oil switch. From this cable a tap is made to a section of the 2,300 volt bus through a second oil switch. Three sections of the bus are connected through other oil switches. The interlocking shall permit using the bus as a transfer from any transformer to any cable, and, simultaneously, shall prevent feeding, at any one time, any bus section from more than one source of power.

The five-switch interlock shall be suitable for interlocking five oil switches. Where these are required, the bus is sectionalized in three parts, adjacent sections being connected through two oil switches. Each section is fed from a separate cable through one oil switch. The interlock shall prevent feeding, at any one time, any section from more than one feeder.

The two-switch interlock shall be suitable for interlocking two oil switches. Certain circuits are fed through two oil switches, and the interlocks shall prevent the closing of either switch when the other is in the closed position.

A total of two (2) eight-switch interlocks, twelve (12) five-switch interlocks and forty-four (44) two-switch interlocks are required. Each interlock shall be provided with a glass cover.

Relay protection, general scheme.

200-38. The general scheme of relay protection is as follows:

Power will be supplied over six radial feeders of 13,200 volts, 3 phase, 60 cycles. Each incoming feeder switch will be provided with short-circuit relays. Step-down transformers have been provided with double secondary windings, one at 2,300 volts and one at 460 volts. These banks shall be provided with differential protection, tripping the high tension and both of the low tension switches. The low tension switches shall be provided with short-circuit relays. The 2,300 volt winding feeds, through an oil switch, a cable from which taps are taken to four busses, each tap feeding through an oil switch. The 460 volt winding feeds a single bus through an oil switch.

All of these oil switches shall be provided with short-circuit relays. These busses feed the ventilating fan motors and other miscellaneous loads through oil switches provided with short-circuit relays. In addition to these relays, the oil switches feeding the ventilating fan motors shall be provided with temperature overload relays suitable for the motor. The current transformers on the motor circuits have, in some cases, 5 ampere and, in other cases, 10 ampere secondaries. Short-circuit relays on the ventilating fan motors and other miscellaneous loads shall be instantaneous, such as the plunger type; all others shall be of the induction type with adjustable time delay. There shall also be overload relays on the 2,300 volt side of the six power transformer banks and one on each 2,300 volt feeder for operation of bell alarm and indicating lamps. The number and type of the relays are as shown on the drawings.

Functions of different relays as outlined herein may be combined in a single relay if approved by the Engineer.

The maximum short-circuit which can be obtained on the 2,300 volt system is 5,450 amperes and on the 440 volt system, 6,050 amperes.

Induction over-current relays.

200-39. The induction over-current relays shall be three phase, composed of three single phase elements grouped together in one case. They shall be suitable for connecting in the 5 ampere secondaries of current transformers, there being three current transformers per relay, all of which have been supplied under another contract. When operating, they shall make one circuit. They shall be back connected and have glass covers. They shall have a target of the hand reset type which will show clearly when the relay has operated.

These relays shall be used for short circuit protection on the six incoming feeders, the 2,300 volt side of the six

power transformer banks, and thirty-six (36) bus feed switches. The relays shall open their circuit and return to the original position when the short circuit has disappeared.

Differential relays.

200-40. Each of the six 3,000 kva transformer banks shall be protected by means of a differential relay scheme. Under another contract, the 13,200 volt side of the bank has been supplied with three current transformers rated at 150/5 amperes, the 2,300 volt side of 2,550 kva capacity, with three current transformers of 800/5 ampere rating, the 440 volt side of 450 kva capacity, with three current transformers rated at 4000/5 amperes.

The Contractor shall supply balancing transformers and differentially connected, three phase induction relays. The three elements of these relays shall be contained in a single glass case with back connected studs and a hand reset target.

The relay shall make one circuit when operating.

Motor protection.

200-41. Each one of the eighty-four (84) ventilating fan motors shall have a protection against short circuits and a separate protection against overload.

The larger motors have been provided with two current transformers of an ampere rating slightly above their full load and a 5 ampere secondary. The smaller motors have two current transformers of an ampere rating slightly larger than twice the full load and 10 ampere secondaries. Six 440 volt motors, supplied from 2,200 volt circuits through individual step-down transformers, have two current transformers with 10 ampere secondaries on the 2,200 volt side and two current transformers with 5 ampere secondaries on the 440 volt side, the former to be used for short circuit protection and the latter for overload. In all other cases, the same current transformers shall be used for both protections.

Instantaneous relays.

200-42. The short circuit protection of the motors shall consist of two instantaneous relays. They shall make one

circuit when operating and shall return to the original position after the short circuit has disappeared. They shall be back connected and all parts covered with glass or metal covers. They shall have a hand reset target. Contacts shall be rated 10 ampere, 125 volt, D. C. They shall trip the oil switches through multi-contact lockout relays in not over one-tenth (0.1) second between the occurrence of the short circuit and the energizing of the trip coil of the oil switch.

Temperature relays.

200-43. The overload protection of the motors shall consist of two temperature relays. These relays shall follow the temperature variations of the motor and shall close their contacts when the temperature limit of the motor has been reached. They shall protect the motor during the long starting periods of one minute duration encountered with the smaller motors.

These relays shall make one circuit, be hand reset and have hand reset targets. Contacts shall be rated 10 ampere, 125 volt. D. C.

Four similar relays are required in each ventilation building for the protection of the battery motor-generator charging sets specified under this item.

Time limit overload relays.

200-44. The lighting feeders, house transformer feeders and pump feeders, of which there are a total of eighteen (18), shall be provided with two inverse time limit overload relays per circuit. They shall make one circuit and return to the original position when the overload has disappeared. They shall have a hand reset target. Contacts shall be rated 10 ampere, 125 volt, D. C. Oil dash pots are not permissible on these relays. Time setting shall be accurately adjustable. They shall be back connected and enclosed under glass or metal covers. They shall operate in the 5 ampere secondaries of the two current transformers of each circuit.

Multi-contact lockout relays.

200-45. All the overload, short circuit and differential relays shall trip their breakers through multi-contact lockout relays. This relay shall have a coil for intermittent service on 125 volt, D. C. When operating, it shall make the tripping circuits of the oil circuit breakers; open the polarity feed to the oil circuit breaker control switches, thereby making it impossible to reclose the switches until this relay has been reset by hand; close a circuit which will short-circuit the pilot light resistor, thereby making the pilot light burn bright; make one circuit and break another for making the pilot light on the supervisor's board burn bright; break one circuit and make another to release the bell alarm relay and break the coil circuit after the relay has operated.

The relay shall have a total of ten (10) contacts, all of which shall be rated 15 ampere, 125 volt, D. C.

It shall have a hand reset target or some other indicator showing plainly and from a distance that the relay is locked out. There shall be a total of one hundred twenty-six (126) of these relays.

Long time delay under-voltage relays.

200-46. The long time delay under-voltage relay shall be for continuous operation from a 125 volt D. C. circuit. When de-energized, it shall close one circuit after an interval of time, adjustable between one-half (½) and five (5) minutes. The contact shall be rated 10 ampere, 125 volt, D. C. and shall operate the multi-contact lockout relay, described hereinbefore. It shall carry a hand reset target or other indicator showing that the relay has operated. When re-energized, the relay shall return quickly to its energized position. It shall be back connected and have a glass or metal cover. There shall be one such relay for each of the forty-two (42) blower and exhaust fan motor sets. This relay shall be energized at all times, except during starting periods and under certain abnormal conditions. It shall protect the motors during the starting and stopping periods and, during operation of the

motors, it shall protect against failure of the speed control devices.

Instantaneous under-voltage relays.

200-47. Together with the long time delay under-voltage relays, there shall be provided forty-two (42) instantaneous under-voltage relays for continuous operation on 220 volt, A. C., 60 cycles. These relays shall make one circuit when de-energized. Contacts shall be rated 10 ampere, 125 volt, D. C. They shall be back connected with glass or metal covers. These relays shall complete the coil circuits of the long time under-voltage relays when the bus potential fails while the motors are running.

Time delay under-voltage relays.

The four tunnel lighting feeders shall be provided with a time delay under-voltage relay, with 110 volt, A. C. coils, for tripping the oil circuit breaker on failure of the supply. It shall make one circuit when energized and break this circuit and make another when de-energized.

Multi-contact relays.

200-48. In each of the eighty-four (84) ventilation fan motor starting cabinets, the Contractor shall install a multi-contact relay as specified in paragraph 200-9. He shall provide and install a small panel and shall mount the relay thereon. He shall provide and install wiring with a terminal board for this relay. This relay shall have a coil for continuous service on 220 volt, A. C. When de-energized, it shall make two contacts. When energized, it shall break these contacts and make two others. Contacts shall be rated 10 ampere, 125 volt, D. C. This relay shall be back connected and have a metal or glass cover. Alongside each one of these relays shall be installed the resistor for making the motor pilot light of this motor on the control board burn bright as specified in paragraph 200-34.

Feeder overload relays.

200-49. Each one of the six 2,300 volt feeders shall be protected from overload by means of a single phase overload relay to be connected in the 5 ampere secondary of a current transformer. This relay shall close two independent circuits when the temperature of the cable has reached a preset value. It shall be back connected

and provided with metal or glass cover. It shall be hand reset and provided with a hand reset target or other indicator. The relay shall not close its contacts during the one minute starting period of the motors. It shall have inverse time limit characteristics.

Transformer overload relays.

200-50. Each of the 2,300 volt sides of the six power transformer banks shall be protected from overload by means of a single phase overload relay of the same type as specified in the preceding paragraph.

Bell alarm relays.

200-51. In each of the four ventilation buildings, located on the control board, shall be a bell alarm relay with a bell alarm relay reset button on the front of the board. This relay shall be for intermittent duty on a 125 volt, D. C. circuit. It shall have a contact to break its own coil circuit and a closing contact for operating seven large gongs at one time. The coil of the relay shall be fed from the multi-contact lockout relays and other devices requiring the bell alarms to ring. The reset coil shall operate at 125 volts, D. C. It shall be so arranged that the bells shall stop ringing when the bell alarm reset button is pushed without the necessity of resetting the lockout relay and without preventing the other lockout relays from operating the bells. The bells shall also be made to ring when the carbon monoxide content is too high, air fails to pass through air blast transformers, or overload exists on transformers or feeders. Besides the equipment listed, the Contractor shall supply all auxiliary relays necessary to perform this operation.

Bells shall ring when a pilot light becomes bright, but after being silenced by the bell alarm reset button, they shall not ring when the light becomes dim again. If the reset button has not been used, the bells shall automatically cease ringing when the light becomes dim.

One of the gongs shall be mounted inside the control cabinet located in the building. It shall be smaller than the others. The other six shall be loud-ringing, mounted on various floors through the building. The sound shall

be such that it can be heard above the sound of fans and motors and by a man standing inside the exhaust chambers on the fan floors. These gongs shall be weatherproof, for conduit wiring. All gongs shall operate at 125 volts, D. C. Wiring for these gongs, in the buildings, shall be installed under Item 199 and is included in the wiring schedule listed thereunder.

Speed control contactors.

200-52. For controlling the speed of the six ventilating fan motors operating on each of the fourteen sections of the tunnel, there shall be three speed control contactors. They shall be 75 ampere contactors with coils for continuous service on 125 volt, D. C. They shall have two contacts normally open and four auxiliary contacts of 10 ampere capacity, of which two shall be normally open and two normally closed. They shall be enclosed in glass covers. A total of forty-two (42) is required.

Current calibrating receptacles.

200-52. The current calibrating receptacles shall be single phase and permit inserting instruments without interrupting the circuit. The potential calibrating receptacles shall be single phase for 110 volt, A. C. With each relay board there shall be furnished six (6) plugs and cords for the current calibrating receptacles and six (6) for the potential calibrating receptacles.

Payment, control boards, storage batteries, etc.

200-54. Payment for the control, relay and distribution boards, storage batteries, battery chargers and control and relay room floor finish will be made at the lump sum price stipulated in Schedule Item 200 (a) for the land ventilation building, New York, or in Schedule Item 200 (b) for the river ventilation building, New York, or in Schedule Item 200 (c) for the land ventilation building, New Jersey, or in Schedule Item 200 (d) for the river ventilation building, New Jersey, which price shall be in full compensation for furnishing and installing the control, relay and distribution boards, storage batteries and battery chargers and to place the concrete floor in the control and relay rooms all in accordance with the drawings and as herein specified, complete, and all expense in connection therewith or incidental thereto.

ITEM 201—SUPERVISORY SYSTEM.

Functions of the system.

201-1. The supervisory system covered hereunder is of the individual wire control type and shall perform four separate and distinct functions:

(a) By means of lights on the operating boards in the chief operator's room in the New York administration building, it will indicate:

The position, whether open or closed, of the various oil switches throughout the buildings;

The speeds at which the ventilating fans are running;

That air is being supplied to the air blast transformers;

Which pumps are running;

If the water level in the various sumps is at a dangerous height;

The condition of the various tunnel traffic signals;

The location from which a fire alarm is sent.

(b) By handles on the operating boards and by relays located in the various ventilation buildings, transformer rooms, etc., it will provide means for opening and closing the oil switches, to vary the speed of the motors and for setting and clearing the traffic signals.

(c) By means of annunciator boards in the two garages, one in each of the administration buildings, it will indicate the point in the tunnel where a fire alarm is turned in.

(d) By means of recording instruments in the New York administration building, it will show the load on the cables and the carbon-monoxide content of the exhaust gases.

The work to be done under this item is shown on drawings Nos. 4 to 10, inclusive, 19, 21 and 24.

Equipment to be furnished.

201-2. Under this and other items of this contract, the Contractor shall furnish and install all the equipment necessary for the control system.

Under this item (201) he shall furnish and install:

The indicating and control equipment in the New York administration building with all wiring therefor up to the terminals of the telephone cable to be installed under Item 197;

The relays and their cabinets in the four ventilation buildings with all internal wiring. The wiring to these cabinets shall be installed under Item 199;

The relays and terminal boards at the various tunnel signal niches with all internal wiring;

The annunciator boards in the two garages in the administration buildings with all relays and wiring to the terminals of the telephone cable to be furnished under Item 197;

The metering boards in the four ventilation buildings and in the New York administration building with the instruments to be mounted and furnished.

Control and indicating equipment.

201-3. The control and indicating equipment to be installed in the New York administration building shall include:

(a) A supervisory control board in the chief operator's room;

(b) A traffic signal control board in the chief operator's room;

(c) A metering board in the chief operator's room.

(d) Storage batteries with their charging and distribution equipment.

Control board.

201-4. The supervisory control board to be installed in the chief operator's room in the New York administration building shall consist of steel cabinets fastened alongside each other, the front faces of the cabinets forming the adjacent panels of the board. Doors shall be provided in the back to permit access to interior connections.

Conduits.

201-5. Under other contracts, conduits will be placed in the floor terminating at the points where the control

boards will be located. The dimensions of the boards shall be approximately as shown on the drawings to fit the conduit layout.

The depth of the cabinets shall be determined by the manufacturer to suit the equipment mounted therein. All cabinets shall have the same depth.

Control board cabinets.

201-6. Each cabinet shall be well braced and closed on the front, top, back and sides. The bottom shall have openings to permit bringing in thereby the conduits and cables for indicating and control purposes. The housing shall be rigid and thoroughly squared to insure that when adjacent housings are mounted together the sides will fit without interstices. The sides and tops shall be of steel not less than one-sixteenth (1/16) inch thick. The fronts and backs shall be of steel not less than one-eighth (⅛) inch thick. All steel shall be smooth, without blisters, waves, wrinkles or other blemishes that will detract from its appearance. Ventilation holes shall be provided in the backs near the top and bottom, screened with fine copper mesh to prevent entrance of dirt.

Doors shall be flush with sunken hinges and shall fit tightly to prevent entrance of dirt to the interior. Each door shall be furnished with a latch, knob and lock and with a stop for the open position.

All steel shall be enamelled on the inside and have a black marine finish on the outside.

There shall be a base board around the cabinets and an ornamental cornice. There shall be narrow vertical mouldings covering the front and back joints between adjacent cabinets.

Where the joint between two adjacent cabinets forms a division between the equipment in two different ventilation buildings the joint shall form a prominent dividing line. Otherwise the joint shall be blind.

Within each cabinet along the sides shall be brackets or shelves for mounting thereon the relays specified herein.

Wiring in cabinets.

201-7. All wires within the cabinets shall be arranged along the walls in a neat, workmanlike manner. Wires shall be No. 18, A. W. G., solid, rubber covered and braided, for 600 volt service, complying with the requirements of Item 193 for rubber covered wire. The wiring shall be supported on moisture proof, fireproof, insulating cleats. All wires shall be brought to suitable terminal boards at the bottom of the cabinet. These boards shall be moulded material and of a design suitable for bringing thereto the wires from the control and indicating circuits from the apparatus controlled. They shall be constructed with insulating partitions between adjacent terminals and each terminal shall be equipped with two (2) screws, one for the wire in the cabinet and one for the incoming wire. Half of these terminals shall have a disconnecting switch of approved design incorporated in the terminal board. The terminal boards shall be similar to those manufactured by the Burke Electric Company or approved equal.

Face of control board.

201-8. The face of the board shall be of the miniature bus type as shown on the drawings. There shall be two busses, one, the upper, showing the New York feed and the lower showing the New Jersey feed. The board shall also show a representation of the two tunnels, the upper representing the north tunnel and the lower the south. These shall have a distinctive color and shall stand approximately one (1) inch from the face of the board.

The miniature bus shall be approximately three-eighths (3/8) inch wide by one-eighth (1/8) inch thick for the main circuits, and three-sixteenth (3/16) inch wide by one-sixteenth (1/16) inch thick for the secondary circuits. The upper bus shall have a bright brass or copper finish and the lower bus shall be nickel-plated. All circuits fed from either bus shall have gun metal or other approved finish.

The finish shall be such as to prevent corrosion or discoloration. Painting the bus will not be permitted.

The miniature disconnecting switches shall be hinged and permit opening to represent the actual position of the switch. There shall be representations of the disconnecting potheads whereby they can be shown connected or disconnected.

Pilot lights.

201-9. There shall be two types of pilot lights all operated from a 12-cell battery.

The type used for circuit breakers and for certain minor indications, as shown on the drawings, shall have a lens approximately one-half (½) inch in diameter.

The type used for major indications as shown on the drawings shall be one (1) inch in diameter.

One of the oil circuit breaker lights shall be green, the fire alarm light shall be red and all others white. For the white and red lights there shall be a baked enameled resistor normally connected in series, causing the lights to burn at normal rating. When the resistor is short circuited under the action of the relays the light by burning bright will indicate an abnormal condition of the apparatus involved. The life of the bulb when burning bright shall be not less than 1,000 hours. There shall be a very marked contrast between the lights burning bright and those burning dim.

Operating switches.

201-10. The oil circuit breaker operating switches mounted on the control board shall be mounted on a common base with the two lights and the unit shall be easily removable from the front of the board. The switch shall have a handle in the shape of a bar. When the switch is closed the handle shall lie as a continuation of the bus and when open it shall be perpendicular thereto.

The electrical connections shall be such that the switch shall serve as two single-pole double-throw switches acting together. Wires to the switch and lights shall be flexible, rubber covered, for 600 volt service, with colored braid.

The operating voltage of these circuits will be 60 volts from positive or negative to neutral, fed from a 60 cell battery.

The contacts shall be suitable for carrying continuously and breaking repeatedly, not less than 0.5 amperes.

There shall be no neutral position on which the switch can remain between the full open and the fully closed positions. A spring action shall bring the switch into one or the other of the two positions.

Mounted on the back of the board shall be two 125 volt fuses for each operating switch for the protection of the relays controlled.

Speed control switch.

201-11. The speed control switch shall be composed of three switches with one removable handle for the three. Each switch shall make two circuits when closed. It shall not be possible to remove the handle without opening the switch contacts. The contacts shall be suitable for carrying continuously and breaking repeatedly not less than 0.5 ampere. The operating voltage will be 60 volts D. C.

Mounted on the back of the board shall be two 125 volt fuses for each speed control switch.

Diagram of connections.

201-12. Affixed to the door of the cabinet shall be the diagram of the connections of the apparatus within the cabinet. This diagram shall be furnished by the Contractor.

Relays in cabinets.

201-13. Mounted within the cabinet shall be the relays for the control of the lights and of the apparatus in the tunnel. The number and type of the relays will be as specified hereinafter.

Fuses.

201-14. In addition to the fuses specified to be mounted with each switch, there shall be nine (9) fuses for switch board lights and nine (9) two-pole, single-throw, 10 ampere, 125 volt switches for the nine fire alarms in the sumps.

Lights.

201-15. Mounted in the top of each cabinet shall be a 120 volt, 50 watt light with flush type push switch. Wires for these shall be brought in a conduit along the top of the cabinets.

Name plates.

201-16. Besides the name plates shown on the drawings, the Contractor shall provide name plates or other approved marks of identification on all busses, circuits, terminals and other points as may be directed. For relays the name plate shall not be placed on the relay itself, but shall mark the place it occupies.

Name plates shall be engraved. Card holders will not be permitted.

Alarm gong.

201-17. Mounted within the cabinets shall be four alarm gongs operated from a 125 volt battery. Coils and mechanism shall be mounted in an iron case. Mounted on the board in convenient places shall be four bell alarm reset buttons.

Anchors for cabinets. Floor finish.

201-18. As a sill for the cabinets the Contractor shall provide angles or channels properly drilled for fastening the cabinets thereto. These shall be complete with anchors for holding them in the concrete floor and shall be set in the floor and the latter finished as provided for under Item 27.

The area of the concrete floor to be placed in this room is about one hundred (100) square yards.

Installing cabinets.

201-19. The Contractor shall locate the cabinets in position, bolt them to the sills, furnishing the necessary bolts, install all outside finish and shall connect to the proper terminals all incoming wires. He shall connect each ground bus to ground cables which will be brought from the concrete under another contract.

Traffic signal control board.

201-20. The control board for traffic signals mounted in the chief operator's room shall be of steel similar in design to the supervisory control board and mounted in a similar manner.

It shall carry lights and switches arranged in two tiers. one tier for the north tunnel and one for the south tunnel. There shall be four (4) signal lights and four (4) control switches for each of the 48 tunnel signal stations, twenty-four (24) in each tunnel. Of this number, three (3) are spares.

In addition there shall be a single luminous sign and switch for each tunnel, controlling the "Stop Engine" signal and two telephone plug receptacles.

Each light and its switch shall be on a common base easily removable from the front of the board without disturbing the other equipment. Wires to the switch and light shall be flexible, rubber covered for 600 volt service, with colored braid.

Lenses.

201-21. The lenses shall be one-half (½) inch in diameter. Two of the four shall be red, one green and one yellow to correspond to the tunnel signs which they repeat. The red shall be of flashed glass or of other approved material which will insure a marked difference in appearance when the bulb is burning bright from its appearance burning dim. The same glass shall be used for the fire alarm lights on the supervisory control board.

In connection with each red light and the "Stop Engine" sign, shall be a resistor, which, when short circuited, will cause the light to burn bright as specified under paragraph 201-9.

Tunnel signal switches.

201-22. The switches for the control of the tunnel signals shall be mounted, each respectively below the light representing the tunnel signal which it repeats. Each of the switches shall have a differently shaped handle, thus differentiating them by shape as well as by position.

The switch below the red traffic light shall have two positions. It shall make one independent circuit in each position.

The switch below the green traffic light shall be spring return push button. It shall make one independent circuit in each position.

The switch below the yellow light shall be two position and shall operate as a single-pole, double-throw switch.

The switch below the red fire signal shall be spring return push button. It shall make one circuit when pressed.

The switch near the "Stop Engine" signal shall be two position, operating as a single-pole, double-throw switch.

All switches shall be designed to carry continuously and break repeatedly 0.5 amperes. Push buttons shall be not less than one-half (½) inch in diameter and shall have a travel of not less than one-half (½) inch.

Equipment for tunnel signal stations.

201-23. Mounted within the cabinets shall be relays as specified hereinafter.

Wiring and terminal board shall be as specified in paragraph 201-7, for the supervisory control cabinet.

In addition to the equipment listed above, to be furnished for each tunnel signal station, there shall also be furnished for the entire board, the following:

Four 125 volt fuses;

Six 3-pole, single-throw, 10 ampere, 125 volt switches;

Two telephone plug receptacles;

Two loud buzzers suitable for operation on 125 volts, D. C.;

Two 120 volt, battery voltage pilot lights, with one (1) inch lenses;

Two bells alarm reset buttons;

One non-magnetic switchboard clock, flush type.

Installation of cabinets.

201-24. The mounting and erection of the cabinets shall be as directed for the supervisory control cabinet.

Storage batteries.

201-25. The Contractor shall furnish and install in the New York administration building, two storage batteries with full charging and control equipment, one battery of 60 cells for the operation of the various relays throughout the tunnel used in the supervisory system and for alarm bells in the supervisory room and one battery of 12 cells for the indicating lights in the supervisory room. The batteries shall be fully charged at the time of their acceptance.

60 cell battery.

201-26. The 60 cell battery shall have a capacity as measured by the 8 hour rate of 160 ampere hours, final voltage, 1.75 volts per cell. It shall be suitable for operation on a polarized circuit of 60 volts plus and 60 volts minus. Terminals shall be brought out at the center as well as at the two ends. In other respects it shall comply with the specifications for the storage batteries to be provided for the four ventilation buildings. Cells shall be installed in three tiers.

12 cell battery.

201-27. The 12 cell battery shall have a capacity as measured by the 8 hour rate of 160 ampere hours. Cells shall be identical with those specified in the preceding paragraph.

Motor-generator battery chargers.

201-28. There shall be two motor-generator battery chargers for the 60 cell battery, designed for charging with a "trickle" charge.

The generator shall be 3 wire shunt wound and shall be able to deliver continuously a load of 20 amperes at 140 volts with a temperature rise not exceeding 40 degrees C. The magnetic characteristics shall be such that the saturation is high at normal operating voltages, thus permitting close voltage regulation and automatic decrease of charging current with increase of charge.

The motor shall be 220 volts, 60 cycle, suitable for starting without starting compensators or resistors, of capacity to drive the generator at full load continuously with a temperature rise not exceeding 40 degrees C.

201-29. The charger for the 12 cell battery shall be a bulb charger, for which the Contractor shall furnish a spare bulb. Bulb charger.

STORAGE BATTERY CONTROL AND DISTRIBUTION PANELS.

201-30. The switching equipment for the storage batteries shall consist of two (2) elements, the motor generator control equipment and the distribution panels. Switching equipment.

The motor-generator control equipment shall consist of a panel with the necessary instruments mounted thereon. The panel shall be of steel, not less than one-eighth (⅛) inch thick with black marine finish, corresponding in appearance to the switch panels to be provided under Item 200 of this contract.

201-31. For each battery there shall be: Equipment for battery.

One D. C. ammeter with special needle stops at both ends of the scale;

One voltmeter with suppressed zero scale, 100-150 volts and special calibration between 126 and 132 volts;

One potential receptacle, six (6) point with four (4) point plug and holder;

Two fuses and holders.

201-32. For each motor-generator charging set there shall be: Equipment for motor-generator charging set.

One contactor, A. C., with one interlock for the motor line and generator shunt field circuits;

One transfer switch, single pole, D. C., heel and toe spring operated;

One contactor, D. C., with interlock for D. C. line;

One lever switch to cut out motor and generator;

One generator field rheostat with hand wheel and mounting;

Fuses and holders for D. C. lines;

Fuses and holders for A. C. lines;

Miscellaneous secondary equipment.

The interlock on the contactors shall automatically open both contactors when the A. C. line fails and automatically close them when voltage returns.

Equipment for bulb rectifier.

201-33. For the bulb rectifier there shall be:

One lever switch 2-pole, single-throw, with fuses;

One lever switch 3-pole, single-throw, with fuses;

Miscellaneous secondary equipment.

Distribution panels.

201-34. The distribution switching equipment for each battery shall consist of distribution boards mounted in niches as described hereinbefore under Item 198 for lighting of buildings. The niches will be provided under another contract.

For the 60 cell battery, there shall be one (1) panel board having a 3-pole, 60 ampere main switch and twenty (20) 3-pole branches, fused for 30 amperes with neutral unfused.

For the 12 cell battery, there shall be one (1) panel board having a 2-pole, 60 ampere main switch and twenty (20) 2-pole branches, fused for 30 amperes.

The niche in which the panel boards are to be installed will be of sufficient size to provide an eight (8) inch gutter on all sides of the board. The Contractor shall provide the niche with a steel cover not less than one-eighth (⅛) inch thick, supplied with a hinged door to cover the switches and fuses. Hinges shall be sunk and each door shall have a knob, latch and lock. Switches shall be of the knife type.

Connecting cables.

201-35. In the New York administration building, the Contractor shall furnish and install lead covered, multiconductor cable, No. 22, A. W. G., solid, 150 volt, insulated with rubber not less than one thirty-second (1/32) inch thick, covered with single code colored cotton covering, as follows:

Between the supervisory control board and the telephone cable terminals furnished under Item 197

of this contract, six (6) lengths, each fifty (50) feet long, averaging two hundred (200) conductors per cable;

Between the traffic control board and the same telephone cable terminals, two (2) lengths, each sixty (60) feet long, of one hundred and fifty (150) conductor cable;

Between the meter board and the same telephone cable terminals, one length, sixty (60) feet long, of fifty (50) conductor cable;

Between the traffic control board and the supervisory control board six (6) lengths, each thirty (30) feet long, of twenty (20) conductor cable;

Between the meter board and the supervisory control board, six (6) lengths, each thirty (30) feet long, of twenty (20) conductor cable.

Lead covered 600 volt wiring shall be provided between battery charging panels and batteries, a distance of twenty-five (25) feet, charging panels and chargers, a distance of twenty (20) feet, and charging panels and distribution panels, a distance of twenty-five (25) feet.

Between distribution panels and the various boards and the telephone cable terminals, the Contractor shall provide 600 volt multi-conductor cable No. 19/22 A. W. G., an average of twenty-five (25) feet per run.

EQUIPMENT FOR VENTILATION BUILDINGS.

Equipment to be furnished.

201-36. The supervisory equipment to be installed in each ventilation building consists of relays mounted within steel cabinets in one of the rooms on the control floor.

Steel cabinets.

201-37. The cabinets shall be of steel, one-sixteenth (1/16) inch thick, closed on the top and four sides but not on the bottom. The sides shall extend to the floor so as to provide complete protection to the equipment

mounted therein and to shut out the dust. The bottom shall be left open to permit entering the control cables.

Ventilation holes shall be left in the front near the top and bottom, screened with fine copper mesh to prevent entrance of dirt. Doors shall be in the front and shall be furnished with latch, knob and lock.

Bolt holes shall be provided to hold cabinets to the floor.

Shelves or brackets shall be furnished on the inside for mounting thereon the relays.

The steel shall be enameled on the inside and shall have a black marine finish on the outside.

The number and approximate floor space occupied by the cabinets, shall be as shown on the drawings. There shall be one cabinet for each switch board panel. The height of the cabinet shall be as determined by the Contractor to accommodate the equipment installed therein. The height of all the cabinets in a building shall be the same.

Equipment.

201-38. Mounted within the cabinet shall be the relays required for operation of the corresponding switch board panel. The number of relays shall be as specified hereinafter.

The apparatus shall be mounted within the cabinet so that any piece is easily removable without disturbing any other piece.

Conduit trench.

201-39. The floors of the buildings will be furnished with an open trench over which the cabinets shall be placed. The conduits carrying the wiring for the cabinets will terminate in this trench.

The Contractor shall furnish a ground bus of two (2) inch by one-quarter (¼) inch copper along the length of this trench and connect the same to the two ground cables

provided under another contract. He shall make all necessary ground connections thereto.

He shall provide concrete partitions in the trench to divide the spaces under the various cabinets and shall provide steel anchors in the floor finish, with the necessary bolts, to hold the cabinets in position.

He shall furnish asbestos flooring, three (3) feet wide, over the trench and supports therefor, as specified in paragraph 200-10.

Installation.

201-40. Erection of the cabinets, wiring, provision of name plates and of wiring diagram shall be as directed for the supervisory control board in the chief operator's room.

Connections.

201-41. Cable connections between the cabinets and the parts of the equipment controlled thereby shall be furnished and installed under Item 199.

Under this item (201), he shall furnish and install cable connections between the cabinet and the cable terminal installed on the control floor under Item 197. There shall be one cable to each cabinet averaging fifteen (15) feet in length and averaging fifty (50) conductors, No. 22 A. W. G., suitable for 150 volt service. The cables shall be lead covered, rubber insulated not less than 1/32nd inch thick and covered with code colored braid.

Annunciator cabinet.

201-42. In each of the two garages on the ground floors of the administration buildings there shall be one forty-eight (48) drop annunciator cabinet of the electrical reset type. The drops shall be suitable for operation on 60 volts, D. C.

The cabinets shall be constructed similarly to those in the supervisory control room.

Mounted in each of the two cabinets shall be:

Relays as specified hereinafter;

Eight fuses, 60 volt, D. C., for relay protection;

Two 3-pole single-throw, 10 ampere, 125 volt switches;

Terminal blocks;
One relay reset switch for each of the 48 positions;
Two annunciator reset switches for the entire box;
One bell-ringing transformer, 110 volt, 60 cycle;
One two-pole, single-throw, 30 ampere, fused switch;
Two 120 volt, pilot lights, with one inch lenses;
One 8 inch gong for 110 volts, A. C., weatherproof, for conduit wiring.

Cable.

201-43. Under this item, the Contractor shall furnish and install in each of the two administration buildings, two fifty (50) foot cables connecting the terminals furnished under Item 197 to the apparatus to be provided hereunder. They shall be fifty (50) conductor, lead covered cable, No. 22, A. W. G., solid, 150 volt. The wire shall be insulated with rubber not less than one thirty-second (1/32) inch thick and with code colored cotton.

Installation.

201-44. Erection of the cabinets, wiring, furnishing of name plates and of wiring diagram, shall be as directed for the supervisory control board.

TUNNEL SIGNALS.

Tunnel signals.

201-45. At each of the 45 tunnel signal locations there shall be the following equipment:

Relays as specified hereinafter;
Four 60 volt fuses for the relay protection;
Three 2-pole single-throw, 30 ampere, fused switches, 125 volt;
One 2-pole heel and toe switch, 10 ampere, 125 volt;
One 4-pole heel and toe switch, 10 ampere, 125 volt;
One terminal board for the apparatus provided hereunder, and for the wires brought in under Items 195 and 197.

These shall be mounted on a factory-made frame which fits the niche. The attention of the Contractor is called

to the fact that there are two types of niches, differing slightly in internal dimensions.

Plaza signal.

201-46. In each entrance plaza, for the single signal provided there, he shall furnish a similar equipment mounted in a cast-iron box to be furnished and installed under this item.

Wiring in niches.

201-47. Wiring in the niches for the lighting circuits and for relay control shall be No. 14 A. W. G., solid rubber insulated and braided, suitable for 600 volts.

MISCELLANEOUS.

Metering cabinets.

201-48. There shall be metering cabinets in each of the four ventilation buildings and in the New York administration building. These carry the carbon monoxide indicators and the load meters. They shall be constructed in accordance with the specifications for the supervisory control cabinets.

Mounted on the metering cabinet in the supervisory room of the New York administration building, shall be two graphic recording wattmeters which will measure respectively the energy received in each land ventilation building simultaneously over three non-synchronized 13,200 volt cables.

Transmitting devices shall be furnished in each land ventilation building, mounted on the metering panel in the control room.

Each cable has been provided with two current transformers, 150/5 ampere capacity, to be furnished under Item 206 of this contract and with two voltage transformers, 13,200/110, furnished under another contract.

Transmission shall be over the No. 22, A. W. G. wire, paper insulated for 150 volt service, to be furnished under Item 197 of this contract. Accuracy of transmission shall be independent of the size of wire and calibration of the wire must not be necessary.

Accuracy of the graphic record shall be such that all errors including those due to transmitting devices and errors in the wire shall not exceed two per centum (2%).

Installation of carbon monoxide recorders.

201-49. The carbon monoxide recorders shall be furnished under Item 202 of this contract and installed hereunder. There will be four in each land ventilation building, three in each river ventilation building and fourteen in the New York administration building.

Installation of load meters.

201-50. The load meters shall be furnished and installed hereunder. There will be two in the New York administration building.

Installation of power companies' meters.

201-51. In each land ventilation building there shall be one cabinet to be drilled hereunder on which will be mounted the instruments of the power companies, the installation of which will be under another contract.

Material of metering panels.

201-52. In the New Jersey land ventilation building, in the front of this last named cabinet, shall be mounted a one and one-half (1½) inch slate panel with black marine finish. All other panels shall be steel of black marine finish as specified for the control board.

Erection, wiring, name plates, etc., shall be as specified for the supervisory board.

RELAYS FOR SUPERVISORY SYSTEM.

Two-position polarized relays.

201-53. Two-position polarized relays shall operate at 60 volts plus or 60 volts minus, with a variation of 10 volts above or below these figures. The current in the coil shall not exceed 0.02 ampere. Coils shall be suitable for continuous duty. A contact shall be able to break repeatedly a one ampere inductive circuit at 125 volts, A. C. or D. C. The contact shall operate as a 2-pole double-throw switch. The relays shall have tight fitting individual covers, insuring against entrance of dirt and moisture. When the relay is de-energized, the relay contact shall remain in position and under this condition it shall be able to carry the full load rating of one ampere at 125 volts, A. C. or D. C.

Three-position polarized relays.

201-54. Three-position polarized relays shall make one independent circuit in each energized position and shall

break both circuits when de-energized. The contacts of these relays shall be suitable for switching the pilot lights on the supervisory control and traffic boards, namely: when the relay is de-energized the light shall be out, when energized in one polarity they shall be made to burn dim, when energized in the other polarity they shall be made to burn bright. In all other respects they shall comply with the requirements for the two-position relays.

Polarized railway signal type relays.

201-55. Polarized railway type signal relays shall conform to the standards of the Signal Section of the American Railway Association. They shall have impregnated coils, wound for continuous duty at 60 volts, D. C. Under the action of the polarized coils there shall be one set of contacts operating as a single-pole double-throw switch. In addition, there shall be one set of contacts closing a circuit when the relay is energized from either polarity and opening the circuit when de-energized. Contacts shall be designed to break repeatedly, four amperes, A. C. The relays shall have tight fitting individual covers, insuring them against entrance of dirt and moisture.

Multi-contact, non-polarized railway type relays.

201-56. Multi-contact, non-polarized railway type signal relays shall, in general, follow the specifications for polarized type railway relays described above. They shall have three sets of contacts operating as single-pole, double-throw switches when the relay is energized or de-energized.

Single contact, D.C. undervoltage relay.

201-57. The single contact, D. C., undervoltage relay shall be wound for continuous duty at 125 volts, D. C. It shall make one circuit when energized. Contacts shall carry continuously 10 amperes, D. C. and shall interrupt 6 amperes D. C. on inductive circuit. The coil shall require not more than 0.3 ampere when energized. It shall have an individual cover.

Double contact, D.C. undervoltage relays.

201-58. The double contact, D. C., undervoltage relay shall be wound for continuous service at 125 volts, D. C. It shall make one independent circuit in each position of the armature. Contacts shall carry and break one am-

pere, D. C. Coil shall require not more than 0.3 ampere when energized.

Double contact, 110 volt, A.C. undervoltage relays.

201-59. The double contact, 110 volt, A. C., undervoltage relay shall be wound for continuous service at 110 volts, A. C. It shall make one independent circuit in each position of the armature. Contacts shall be rated at one ampere, D. C. It shall have an individual cover.

Double contact, 220 volt, A.C. undervoltage relays.

201-60. The double contact, 220 volt, A. C., undervoltage relay shall be wound for continuous service at 220 volts, A. C. It shall make one independent circuit in each position of the armature. Contacts shall carry and break one ampere D. C. It shall have an individual cover.

Relays required.

201-61. The number of relays to be furnished for the supervisory control is as follows:

TWO-POSITION POLARIZED RELAY, NON-RAILWAY TYPE.

New York land building	54
New York river building	35
New Jersey river building	33
New Jersey land building	68
Supervisory control cabinet	190
Traffic control cabinet	88
Tunnel niches	88
In carbon circuit breaker boxes	8
Spares	10

THREE-POSITION POLARIZED RELAY, NON-RAILWAY TYPE.

New York land building	4
New York river building	3
New Jersey river building	3
New Jersey land building	4
Supervisory control cabinet	442
Traffic control cabinet	47
Spares	10

POLARIZED RELAY, RAILWAY TYPE.

New York land building	4
New Jersey land building	4
Tunnel niches	88

NON-POLARIZED, MULTI-CONTACT, RAILWAY TYPE RELAY.

Supervisory room	43
Emergency room, New York	43
Emergency, room New Jersey	43

D. C. UNDERVOLTAGE RELAY, SINGLE CONTACT.

New York land building	207
New York river building	102
New Jersey river building	96
New Jersey land building	207
In carbon circuit breaker box	16
Spares	10

D. C. UNDERVOLTAGE RELAY, DOUBLE CONTACT.

New York land building	50
New York river building	36
New Jersey river building	36
New Jersey land building	50
Spares	2

110 VOLT, A. C., UNDER VOLTAGE RELAY, DOUBLE CONTACT.

New York land building	3
New Jersey land building	3

220 VOLT, A. C., UNDER VOLTAGE RELAY, DOUBLE CONTACT.

A total of 46 is required, distributed in the various lighting cabinets.

Bell alarm relays.

201-62. There shall be four identical gongs for the supervisor's control board which shall ring whenever a pilot light in their section is burning bright.

By means of four push buttons, located on the board, it shall be possible to stop the gongs ringing while the light remains bright.

Under this condition the gongs shall be ready for operation from other lights. When the light returns to a dim condition, the gong shall not resume ringing.

There shall be one loud buzzer on the traffic control board which shall ring in a way similar to the gongs of the supervisor's control board. In addition to the relays listed in Section 201-61, the Contractor shall supply and install all relays necessary to perform these operations.

Payment, supervisory system.

201-63. Payment for the supervisory system will be made at the lump sum price stipulated in Schedule Item 201, which price shall be in full compensation for furnishing and installing the supervisory system in accordance with the drawings and as herein specified, complete, and all expense in connection therewith or incidental thereto, including finishing a concrete floor in the New York administration building.

ITEM 202—CARBON MONOXIDE RECORDERS.

Locations of recorders.

202-1. The Contractor shall furnish and install, four composite carbon monoxide recorders, as follows:

One, composed of four units, to be located in the CO recorder room on the first floor of the New York land ventilation building;

One, composed of three units, to be located in the CO recorder room on the pier deck floor of the New York river ventilation building;

One, composed of three units, to be located in the CO recorder room on the pier deck floor of the New Jersey river ventilation building;

One, composed of four units, to be located in the CO recorder room on the first floor of the New Jersey land ventilation building.

The three or four units, as the case may be, shall be in a single bath.

The carbon monoxide recorders shall be of the type manufactured by the Mine Safety Appliance Company or an approved equal.

Table and backboard.

202-2. The lumber of the table and backboard where visible, shall be quarter sawed oak. All joints shall be doweled, pinned and glued. The finish shall be natural

oak, varnished two coats, and rubbed, except the lower shelf which shall be finished with a bright coat of black shellac. The back board shall be of Haskelite, three-quarters (¾) inch thick, ply wood surfaced and edged with quartered oak, made by the Haskelite Manufacturing Co., Chicago, Ill., or an approved equal.

Recorders.

202-3. Two continuous graphic recorders shall be furnished for and connected to each unit, one at a distance of about 200 feet from the analyser and one at a distance of about 7,000 feet. The near one will be connected to the analyser through a circuit of No. 10, A. W. G. wire and the distant recorder through a circuit of No. 22 A. W. G. wire. The wire in both circuits will be suitable for a maximum voltage of 140 volts. The use of calibrated wires is not approved. These wires are to be furnished under other items of this contract.

The graphic recorder shall have a paper speed of about four (4) inches per hour and the lateral movement of the pen shall be about one (1) inch to one part of CO in 10,000. The permissible error of the graphic recorder, including errors in the analyser and errors of transmission shall not exceed five parts in 100,000. These instruments shall be suitable for mounting on steel panel boards provided under Item 201 of this contract. They shall be furnished and mounted under this item.

On each recorder shall be adjustable automatic alarm contacts. The alarm shall be effected by making the CO pilot light burn bright while normally it burns dim and also by causing the bells to ring. It shall be possible to stop the bells from ringing while the CO content is still above the alarm setting without preventing the bells from ringing for other causes. When CO content decreases below the alarm setting the bells shall not ring and the bells shall automatically become again operative for the particular recorder. The Contractor shall supply under this item, all contacts on recorder and auxiliary relays required to perform this operation. If energy is

required for operation of this device, it is available at 60 cycle, three-phase, 220 volts, A. C., or single-phase 110 volts, A. C., or from a 60 cell storage battery, both with the usual fluctuations in voltage experienced in industrial installations. If potentiometers are used for graphic recorders they shall be of the Leeds & Northrup type, or equal.

Thermocouple cell and box.

202-4. The hopcalite used in the cell shall be new production, sized between screens of eight (8) and of twenty (20) meshes per inch, and shall fill the cell evenly to a depth of three and thirty-eight one-hundredths (3.38) cm. The remaining space in the cell shall be filled with granular pumice stone, eight (8) to twenty(20) mesh size. The cell shall be shaken and tapped to condense the granular materials as much as possible during the filling and the materials shall completely fill the cell when the cover is attached.

Wrought brass shall be used for constructing the box which contains the cell. Cast brass is permissible, if after machining, it is thoroughly tinned over the inner and outer surfaces. The contact surfaces and threads shall be finished after the tinning. All the metal parts and joints shall be permanently air tight when tested with five (5) pounds per square inch air pressure both before and after repeated heating to 100° C.

Serial numbers.

202-5. Every cell shall have a serial number permanently stamped on the top plate and on the bottom plate. The same serial number shall be applied to the entire carbon monoxide recorder.

Condenser.

202-6. The condenser above the steam bath shall have a pyrex glass liner one-half (½) inch inside diameter by thirty (30) inches long, beveled at the lower end. The water jacket shall be eighteen (18) inches long. The clamp support shall be of the type manufactured by the H. Thomas Co., Philadelphia, Pa., No. 3201, ten (10) inch

size with clamp holder No. 3214, or an approved equal. Rubber tube (one-quarter (¼) inch size, heavy wall) shall be used to lead water from the tap into the condenser, from the condenser into the water supply trap on the steam baths and from the outlet of the trap to the waste pipes.

Electric heaters.

202-7. Electric heaters used in the equipment shall be provided with extra heavy heat insulation to reduce the radiation losses to a minimum. Since the use of these heaters will be continuous throughout the year, it is of importance to minimize the amount of current used. Means shall be provided for adjusting the heat to the smallest amount required for proper operation of the device. The source available for heating is 220 volts, 60 cycle, single or three phase, A. C.

Motor, blower and mounting.

202-8. The motor shall be proper size for the duty; voltage and current to be 220 volt, 60 cycle, A. C. The blower shall be of the type manufactured by Leiman Brothers, Newark, New Jersey, size A, or an approved equal, painted black, made with a stuffing box at the shaft, packed air tight to prevent inward leakage. The motor and blower shall be mounted on a two (2) inch by ten (10) inch by twenty-four (24) inch board; they shall be connected through a one (1) inch leather belt with pulleys to run the blower at 600 r. p. m., or other approved speed. The blower shaft bearings shall be provided with oil cups, one-half (½) ounce capacity, brass finish, one-eighth (⅛) inch pipe thread, one on each bearing. These cups shall be Lunkenheimer "Royal" with sight feed, or approved equal; the sight feed glass shall have a gasket at top and bottom to prevent leakage of air inward. A similar oil cup one and one-half (1½) ounce capacity, one-quarter (¼) inch pipe thread, shall be placed in the oil port at the gas inlet of the blower. The board shall set upon four (4) artgums, each two (2) cubic inch size, one at each corner of the board. The

board shall be gained out and a reinforcing strip three-quarters (¾) inch by one and one-quarter (1¼) inch hardwood inserted in each and across the grain of the wood and glued. A one-half (½) inch by two (2) inch hardwood block, mortised out one (1) inch by two (2) inches to engage the artgums, shall be tacked under each corner of the board. All surfaces of the board shall be planed smooth and finished with a bright coat of black shellac.

Acid bottles and traps.

202-9. The acid bottles and traps shall be of heavy glass of four (4) liters capacity, with wide mouth to take a No. 12 or No. 13 rubber stopper. The glass tubes leading in and out of the bottles shall be three-quarters (¾) inch plus or minus, one thirty-second (1/32) inch inside diameter and approximately (1/16) inch wall. The stoppers shall be bored to receive them with airtight fit. A loop fastener of soft iron wire, No. 14 size, shall be furnished with each bottle to hold the stoppers firmly in place, but shall be easily removable by hand, for changing acid or cleaning. The glass tubes shall be joined from bottle to bottle, to pipe from blower, and to pipe on backboard, with rubber nipples. The alinement must be straight in each case so that the nipples do not kink or bend, and the butt ends of glass or glass to metal shall be separated a distance of one (1) inch. Any necessary alinement shall be made through bends in the glass tube.

Brass tubing.

202-10. Seamless brass tubing shall be used on the backboard.

All exposed brass tubing, ells, tees, unions, sheet metal jackets and water reservoirs shall be polished and lacquered.

Canister.

202-11. The canister, U. S. Army type H 1918, or an approved equal, shall contain six hundred (600) c. c. or more of a mixture of activiated charcoal and soda lime. The charcoal shall be eight (8) to fourteen (14) mesh size, have forty (40) minute life by accelerated chloro-

picrin test and constitute sixty (60%) per centum by volume. The soda lime shall be eight (8) to fourteen (14) mesh size, approximately five per centum (5%)NaOH as made for gas mask purposes, and constitute forty per centum (40%) by volume. Two filters of absorbent cotton one-quarter (¼) inch thick between wire screens shall be included in the canister. The canister shall be soldered to the brass tubing connections at top and bottom.

Flowmeter.

202-12. The U tube of pyrex glass shall be soldered into the metal head of the flowmeter. This may be done by producing a silver coating on the glass by wetting with a solution of silver nitrate and glycerine in water, reducing the silver metal by heating (not excessively) over a flame, electroplating adherent copper over the silver deposit, tinning over the copper and then soldering into position. The glass shall fit into the metal junction tubes which have been previously tinned inside, at least one-quarter (¼) inch.

The flowmeter shall deliver the volume of gas required by the cell, as determined by the cell calibration in the laboratory, at a head of not less than twenty (20) cm. nor more than sixty (60) cm. of water. The flowmeter as finally arranged to give the desired flow and head shall be calibrated for air flow in liters per minute against head of water in centimeters by means of an accurate gas testing meter joined to the exit for gases (open end of calcium chloride tube) when the carbon monoxide recorder is fully assembled. The calibration shall include at least five (5) points at intervals within the range of the flowmeter and the points shall fall on a smooth curve so that the desired flow and corresponding head may be read from the curve. A statement of the flowmeter calibration shall accompany each instrument as mentioned under "Calibration of cell with carbon monoxide."

Calcium chloride tubes.

202-13. The calcium chloride tubes of pyrex glass (walls one-sixteenth (1/16) inch or more in thickness),

shall be fitted with stiff screens of monel metal wire, No. 20 B & S gauge, to support the calcium chloride. The calcium chloride shall be anhydrous and in one-half (½) to one (1) inch lumps. The calcium chloride tubes shall be stoppered with rubber stoppers which shall be bored to fit the brass tubes entering, with a gas tight fit. The longer calcium chloride tube shall be joined at the small end to the brass tube with litharge-glycerine cement or by soldering. (A permanent gas tight joint is required). The glass tube shall be narrowed to enter the brass tube one-half (½) inch and fit closely through that length, before cementing.

Electric wires.

202-14. The two leads between binding posts on the stage above the thermocouple cell and the binding posts on the recording potentiometer shall be No. 14 B & S gauge, rubber covered, copper wire, taped together or bound into a cable. All bends shall be at right angles, the wires running only vertically and horizontally and connecting the binding posts through the most direct path conformable.

Other exposed leads shall be silk and rubber covered, stranded, lamp cord, equivalent to No. 14 A. W. G. gauge.

Calibration of cell with carbon monoxide.

202-15. The following or some other approved method shall be used in the calibration of the cells. The cell with the recording potentiometer shall have the "best rate" of gas flow determined by passing air containing carbon monoxide in uniform concentration of five (5) parts per ten thousand (10,000). This should be done in a laboratory equipped for the purpose. At least eight (8) points shall be determined to correlate the potential developed against the rate of flow according to gas meter. The curve of potential vs. rate of flow resulting therefrom shall be convex with a drop in potential on each side of the maximum potential. The flow producing the maximum potential shall be taken as the "best rate." Calibration of the carbon monoxide recorder at the best flow

rate shall then be made against five (5) or more concentrations of carbon monoxide in air between one (1) and eight (8) parts per ten thousand (10,000). The concentrations must be accurately known, as by synthecizing carbon monoxide and air mixtures by means of calibrated flowmeters, the undiluted carbon monoxide being of a purity accurately known. The potentials plotted against the concentration of carbon monoxide shall fall closely upon a straight line which shall be taken as the calibration for the instrument. The points determined for each concentration shall not lie away from the line of calibration in excess of four-tenths (0.4) millivolts in any instance nor average more than two-tenths (0.2) millivolts.

A statement of the serial number of the cell, a statement of the determination of the best rate of flow, a statement of the concentrations of carbon monoxide in air used in calibrating the cell, together with the respective millivolts generated, and a statement of the calibration of the flowmeter on the apparatus accompanying the cell shall be submitted with the carbon monoxide recorder.

Sampling tubes shall be of seamless brass tubing of proper size; these tubes are to be installed between the various units and the exhaust air ducts. They are to be properly supported and provided with a sufficient number of unions so that tubes may be removed easily for cleaning. The tubes shall terminate in the exhaust air ducts at about the center of the duct in a goose neck pointing in the direction that the air is flowing.

Instruments are to be guaranteed by the Contractor for a period of one (1) year, during which time the equipment shall be inspected at least once a month and the necessary adjustments made to insure its correct functioning. After the installation of the equipment the manufacturer shall calibrate it, and he shall also instruct

the Commissions' employees in the care, operation and maintenance of the equipment.

Payment, carbon monoxide recorders.

202-16. Payment for carbon monoxide recorders will be made at the lump sum price stipulated in Schedule Item 202, which price shall be in full compensation for furnishing and installing the four (4) carbon monoxide recorders in accordance with the drawings and as herein specified, complete, and all expense in connection therewith or incidental thereto, including instructing the Commissions' employees in the operation and care of the recorders.

ITEM 203—MISCELLANEOUS EQUIPMENT.

Additional equipment.

203-1. In addition to the equipment specified under the other items of this contract, the Contractor shall provide and install two motor-generator battery charger sets for charging batteries of electric trucks purchased under another contract, and certain testing equipment as listed herein.

Battery chargers.

203-2. There shall be two motor-generator battery chargers, one to be installed in the New York administration building and one in the New Jersey administration building. The battery charger shall consist of a motor driven generator. The generator shall be direct connected, 25 kw., 115 volts, D. C., flat compounded for 115 volts, and shall be compound wound with commutating poles. The motor and generator shall be mounted on a common cast-iron bedplate. The motor shall be 3 phase, 60 cycle, 220 volts. When the generator is delivering 25 kw. at 113 volts for an indefinite period, the temperature rise shall not exceed 50° C. on either motor or generator.

Switching equipment.

203-3. The switching equipment shall be mounted on a unit frame. The generator control shall be equipped with an ammeter, voltmeter, a main line circuit breaker to provide for over-load and reverse current protection, and a field rheostat.

The motor equipment shall include a safety switch, a three-pole contactor opening automatically on overload and two temperature relays.

The equipment shall also include charging equipment of the "Sarvas" type for four batteries. Each such separate battery charging equipment shall be of 100 ampere capacity and shall include a two-pole line knife switch with overload fuse protection and with magnetic contactors so arranged that they will open the charging circuit when the current falls below 5 amperes, and also an adjustable resistance to give a range of from 10 to 100 amperes for each battery to be charged.

There shall also be furnished an indicating lamp to show when a battery is on charge.

All of the above shall be mounted on a slate panel one (1) inch thick with black marine finish.

Work to be done.

The work to be done under this item includes the installation of one set in each of two garages, all interconnection of the apparatus herein specified and connections to the supply cables.

With each set shall be furnished four 2-conductor cables, each fifty (50) feet long, size 2/0, extra flexible, suitable for use in garages for automobile battery charging. These shall be complete with suitable terminals at each end, one for connection to the panel and one to the battery. The terminals shall be such as to prevent making wrong polarity connections.

An approved rack for hanging up the cables when not in use shall also be furnished and installed in each building.

TESTING EQUIPMENT.

Testing equipment.

203-4. The Contractor shall furnish the following testing equipment:

Group A.

Instruments and meter transformers as manufactured by the Weston Electrical Instrument Corporation, Newark, N. J., or approved equal. The figures in parentheses indicate the page number in the Weston Corporation's general catalogue, 1926, where said instruments are described.

Item I.—One polyphase two element Weston electro-dynamic wattmeter, model 329 for 5 & 10 amperes, 150 & 300 volts normal, 150 scale divisions (page 50).

Item II.—One single phase Weston electro-dynamic wattmeter, model 310, form 1, for 5 & 10 amperes, 150 & 300 volts normal, 150 scale divisions (page 44).

Item III.—Two Weston electro-dynamic voltmeters, model 341, 150 & 300 & 600 volts (page 51).

Item IV.—Two Weston electro-dynamic ammeters model 370, 5 & 10 amperes, 100 scale divisions (page 56).

Item V.—One Weston voltmeter, model 155, 150 & 600 volts, 150 scale divisions (page 23).

Item VI.—One Weston ammeter, model 155, 5 & 10 amperes, 100 scale divisions (page 24).

Item VII.—Two Weston potential transformers, model 311, 2200 & 1100/110 volts, 25 to 133 cycles (page 47).

Item VIII.—One Weston potential transformer, model 457, 2200 & 550/110 volts, 50 to 150 cycles (page 69).

Item IX.—Two Weston current transformers, model 312, 25 & 50 & 100/5 amperes, 25 to 133 cycles (page 47).

Item X.—Two Weston current transformers, model 312, 50 & 100 & 200/5 amperes, 25 to 133 cycles (page 47).

Item XI.—One Weston D. C. voltmeter, 150/75 volts, model 280 (page 39), in leather case.

The equipment in group A shall be delivered within six (6) weeks after the date of the delivery of the contract.

Group B.

The following instruments, sold by James G. Biddle, electrical instruments, Philadelphia, Pennsylvania, or approved equal:

Item I.—One Evershed Megger No. 652-b, 1000 volts, 0 to 200 and 0.02 to 20 meg-ohms, with one leather carrying case No. 660.

Item II.—One resistance box C-9999 ohms for Item I, with leather case.

Item III.—Three Jagabi sliding contact tube rheostats No. 1514, 2, 4 ohms, 16 amperes.

Item IV.—One Jagabi sliding contact tube rheostat No. 1505, 220 ohms, 1.6 amperes.

Item V.—One Jagabi sliding contact tube rheostat No. 1500, 3200 ohms, 0.3 amperes.

Item VI.—One Jagabi tachometer No. 5204, range, 30-4000 r. p. m.

Item VII.—Two Jagabi speed indicators No. 920 with case.

Item VIII.—Two magnetos, 35,000 ohms.

The equipment in Group B shall be delivered within six (6) weeks after the date of the delivery of the contract.

Group C.

The following or approved equals:

Item I.—One Elgin seven jewel stop watch.

Item II.—One Westinghouse cycle counter, 60 cycles, 100 volts, style No. 237,124.

Item III.—One Westinghouse D. C. auxiliary relay for oil circuit breaker timing, style No. 252,248.

Item IV.—One meter testing rheostat, 110 volts, ¼ to 30 amperes, GE 119,439.

Item V.—One portable power factor meter, 110 volts, 5 amperes, 3 phase, Westinghouse, Style No. 177,039.

Items II and III are described in the Westinghouse general catalog of June, 1925, on page 550.

Item V is described on page 532.

Item IV is described in the General Electric Company's catalog 6001B, on page 637.

The equipment in Group C shall be delivered within six (6) weeks after the date of the delivery of the contract.

Group D.

The style numbers and the page numbers in this group refer to the Westinghouse general catalog of June, 1925. The equipment is to be Westinghouse or approved equal.

Item I.—One oil drying and purifying outfit of the filter press type, capacity five (5) gallons per minute, with a 3 phase motor for 220 volts, 60 cycles, type B-5, style No. 232,169, page 636, mounted on four casters; also 2400 sheets of filter paper, fifty (50) feet three-quarters (¾) inch all steel, flexible hose, with four unions for pipe connections and a fused safety switch mounted on the press.

Item II.—One filter paper drying oven for 220 volts, 100 and 200 and 400 watts, type B, style No. 175,515 (page 638).

Item III.—One portable oil testing set, 3 kva, 30,000 volts, including oil testing cup, Westinghouse Company style No. 368,367, for 220 volts (page 632).

Item IV.—One portable type R, motor operated recording ammeter for 5 amperes, 60 cycles. Control circuit 110 volts, 60 cycles, similar to style No. 289,-426, but with a hand wound clock for timing the paper at speeds variably from 2 to 4, 8 and 24 inches per hour, also ten rolls of paper without time markings but 50 divisions, style No. 372,735 (pages 514 and 516).

Item V.—Two polyphase type OA watthour meters, 5 amperes, 100 volts, 60 cycles, style No. 276,503 (page 480).

Items IV and V in Group D shall be delivered within

six (6) weeks after the date of the delivery of the contract, the remainder by February 1, 1927.

Payment, miscellaneous equipment.

203-5. Payment for miscellaneous equipment will be made at the lump sum price stipulated in Schedule Item 203, which price shall be in full compensation for furnishing and installing the battery chargers and switching equipment and furnishing and delivering the testing equipment all as herein specified, complete, and all expense in connection therewith or incidental thereto.

ITEM 206—INSTALLATION OF TRANSFORMERS AND OIL SWITCHES.

Scope of the work.

206-1. Under other contracts the Commissions have purchased air blast power transformers and oil switches which will be delivered in the various ventilation buildings. The Contractor shall install the same and make all necessary electrical and mechanical connections.

The work to be done under this item is shown on Drawings Nos. 4 to 7 inclusive, 13 and 14.

Number, size and location of transformers.

206-2. There will be eighteen (18) air blast transformers, nine (9) in the New York land ventilation building at the south end of the fifth floor and nine (9) in the New Jersey land ventilation building on the north side of the first floor, the latter on a bench about four (4) feet above the floor. These transformers will be delivered on the floor where they are to be installed in their final location, it may, however, be necessary to make slight adjustments in their positions under this contract. Their net weight is 7,200 pounds each and their dimensions 27 inches by 42¼ inches by 96 inches high. They are single phase, 60 cycle and have three windings respectively for 13,200 volts, 2,300 volts and 460 volts. The three windings are bottom connected. At the bottom are also two terminals of a temperature indicator wound in the transformer coils and a terminal of a ground connection.

Installation of transformers.

206-3. The Contractor shall move the transformers to their correct locations and shall grout them in position

making an air tight joint between the transformer frame and the floor. No traveling crane has been provided for this purpose. The upper end of the transformers shall be connected to a steel air duct which will carry away the heated air. This duct and the steel to connect the transformer thereto will be provided under another contract. Joints shall be air tight. He shall ground each frame to a ground bus to be installed by him in the air chamber under the transformers and connect the bus to two ground cables furnished under another contract.

Connections to transformers.

206-4. The transformers in each building shall be set in banks of three (3) over three (3) air chambers. He shall connect in delta the various windings of the three transformers of a bank as shown on the drawings. He shall connect to the windings the cables to be installed by him under Item 199 of this contract. He shall connect the terminals of the temperature indicator to the control cable from the switch board to be installed by him under Item 199 of this contract.

Indicating vane.

206-5. Below each transformer at the air intake, the Contractor shall furnish and install a vane or other approved device with electric connections to indicate the passage of air through the transformer. This indicator shall operate like a 2-pole, double-throw switch. He shall connect to this certain of the wires in the control cable to be installed by him under Item 199 of this contract.

Connections to cooling fan motors.

206-6. For each bank of three transformers there will be furnished and installed under another contract a 10 H. P. motor driving a fan which will supply the cooling air to the transformer bank. The wires, exposed conduit and safety switch for this shall be furnished and connected to the motor under Item 199 of this contract. Under this item (206) shall be done the work of connecting the wires to the transformers.

206-7. As part of the work of installing the transformers, the Contractor shall dry out the windings. This

work shall be done electrically. The cost of the energy will be paid by the Commissions.

Location and size of 13,200 volt oil switches.

206-8. In each land ventilation building, on the same floor with the aforesaid transformers, will be seven (7) 13,200 volt, truck type, oil switches furnished under another contract and eight (8) housings for the same. They will be delivered in the building on the floor where they will be finally located or at the option of the Contractor on another floor. The oil switches are General Electric Type H 203. The weight of the truck with the oil switch is about 4500 pounds and its dimensions about four (4) feet six (6) inches by three (3) feet six (6) inches by about seven (7) feet high, over which is mounted the operating mechanism, about three (3) feet high. The housing is in three parts, the dimensions of the largest being about five (5) feet three (3) inches by six (6) feet by seven (7) feet high and the weight about 1000 pounds. In addition there will be six superstructures in each of the land ventilation buildings to house the potential transformers. The dimensions of these superstructures will be about six (6) feet by five (5) feet by four (4) feet.

The operating mechanisms for the switches will be shipped separately and shall be assembled under this contract.

Auxiliary equipment.

Busbars and current transformers will be shipped mounted in the housings. Bars for connecting together the sections of busbars in adjacent housings will also be shipped separately with connecting bolts.

Wiring.

Complete main and auxiliary wiring of the truck has been made. All cables and electric inter-connections between the housings will be furnished but not mounted in place. Also a terminal board for the connection thereto of the control wiring will be furnished installed in position.

Bolts.

Under other contracts, there have been buried in the floors, angle irons drilled for holding down bolts and in the walls, inserts for three-quarters (¾) inch bolts.

The angle irons in the floor have been set to template. Holding down bolts shall be furnished under this contract.

Installation of 13,200 volt oil switches.

206-9. The work of installation under this item shall include:

Painting heavily with hot asphalt the walls and all steel parts to be fastened against the concrete walls or against other housings. (Asphalt paint will not be acceptable for this purpose);

Locating the housings in position;

Bolting them to the floor angles and wall inserts;

Bolting together the various sections and superstructure of a housing;

Covering the joints between adjacent housings with finishing strips furnished under another contract;

Putting in place the electric connections furnished, between adjacent housings and between the various sections of the same housing. These connections are being furnished under another contract;

Insulating with 15,000 volt insulation, the bus connections between adjacent housings, and all other work necessary to make a complete finished job.

From a mechanical standpoint the work shall be done with the greatest care to insure that the trucks are interchangeable between housings and that they will fit equally well in any.

The Contractor shall connect to the switch terminals the 13,200 volt cables to be installed by him under Item 199 of this contract and shall connect to the terminals the control wires to be furnished and installed by him under Item 199 of this contract.

He shall ground each housing to an existing ground cable brought out of the concrete floor at a point near the housing.

In each land ventilation building, he shall furnish and install in the housing a total of six (6) current transform-

ers, type G. E. K. 48, of 150/5 amperes, with secondary wiring to the terminal board.

For each 13,000 volt housing, the Contractor shall furnish, install and connect to the terminal board, four secondary contacts similar to those already installed on the housings. On each of the fourteen trucks, he shall furnish and install two auxiliary switches and four secondary contact parts. These switches shall open and close with the main oil switch. He shall furnish all wiring for these contacts. He shall furnish and install a terminal board in each housing to accommodate the four wires from these contacts.

Care shall be taken in assembling the equipment not to mar the finish. The Contractor shall retouch all scratched or marred surfaces.

Location and size of 2,300 volt oil switches.

206-10. In each land ventilation building on the same floor with the aforesaid air blast transformers and 13,200 volt oil switches and on the first floor of the two river ventilation buildings, 2,300 volt, G. E. Type 132 B, truck type, oil switches will be delivered under another contract on the floor where they are to be installed.

The number and location of these switches is as shown on the drawings. The total number of housings in the four ventilation buildings is one hundred ten (110) and of trucks, one hundred (100).

The dimensions of the trucks are about two (2) feet four (4) inches by three (3) feet six (6) inches by about six (6) feet three (3) inches high, weighing about 1800 pounds, and the dimensions of the housings are about two (2) feet eight (8) inches by five (5) feet ten (10) inches by seven (7) feet, weighing about 800 pounds. Over a number of the housings, as shown on the drawings, will be superstructures furnished with the switches, and over many of them will be superstructures to be furnished and installed under Item 207 of this contract.

The 2,300 volt trucks will be shipped completely assembled. The 2,300 volt housings will be shipped with

the superstructures, disconnecting switches, current and potential transformers and connections completely assembled except as noted below.

The copper bus bars, finishing strips, ground busses, and the covers for D. C. operating busses will be shipped disassembled. The D. C. operating busses and the taps from the D. C. operating busses will be shipped in bulk. The Contractor shall solder and tape these taps to the existing wires.

Under other contracts there have been buried in the floors of the ventilation buildings, angles set to template, drilled for holding down bolts. These holding down bolts shall be furnished under this contract.

In the concrete walls back of the switches will be ducts to carry the cables to be furnished by the Contractor under Item 199 of this contract to connect together the bus sections.

Installation of 2,300 volt oil switches.

206-11. The work of installation of the 2,300 volt oil switches shall include:

Covering with hot asphalt the walls and all steel parts to be fastened to concrete walls or to each other;

Locating the housings in position;

Bolting them to the floor angles;

Covering the joints between adjacent housings and between housing and superstructure with finishing strips furnished under another contract;

Mounting bus bars in position;

Connecting to adjacent bus sections the connecting cables specified under Item 199;

Furnishing at the back of the east bus in the New York land ventilation building the two sets of bus-bars connecting adjacent bus sections together with their supporting insulators and protective steel casings. The casing shall be of one-eighth (⅛) inch steel and there shall be insulating barriers between bus bars. The busses shall be of four (4) inch by one-quarter (¼) inch copper;

Connecting to the switch terminals, to the terminal board for the auxiliary wiring and to the D. C. control bus, the power cable and the control cable to be furnished under Item 199;

Complete assembly of all parts.

Quality of work.

From a mechanical standpoint the work shall be done with the greatest care to insure that when completed all housings shall be identical and that any truck will fit in any housing.

Care shall be taken in assembling the equipment to prevent marring the finish. The Contractor shall retouch all scratched or marred surfaces.

The Contractor shall ground at two points the ground bus installed in each switch bank. For this purpose a ground cable will be brought out from the floor concrete at a point near the ground bus.

Payment, installation of transformers and oil switches.

206-12. Payment for the installation of air blast power transformers and 13,200 volt and 2,300 volt oil switches will be made at the lump sum price stipulated in Schedule Item 206, which price shall be in full compensation for furnishing all the material and labor required to install the transformers and oil switches in accordance with the drawings and as herein specified, complete, and all expense in connection therewith or incidental thereto, including drying out transformers, except that the cost of the current will be paid for by the Commissions.

ITEM 207—440 VOLT OIL SWITCHES AND TRANSFORMERS FOR CONTROL.

Scope of the work.

207-1. Under this item the Contractor shall furnish and install sixty-four (64) truck type, 440 volt, oil switches complete with current and potential transformers and housings, and twenty-eight (28) 60 cycle, 2,300 volt transformers for control purposes.

The work to be done under this item is shown on Drawings Nos. 4, 5 and 12.

Location of switches.

207-2. There will be thirty-two (32) oil switches on the fifth floor of the New York land ventilation building and thirty-two (32) on the mezzanine floor of the New Jersey land ventilation building.

Arrangement of switches.

207-3. As described hereinafter and as shown on the drawings, the switch bank is in two tiers, one switch directly over the other. The housings are supported on angles imbedded in the floor. The switch in the upper tier is to be removed and replaced by means of a wheeled platform on rails imbedded in the floor and parallel to the switch bank. All of which shall be furnished hereunder.

Installation.

207-4. The work of installation shall include:

Locating the floor supports. (The pouring of the finish concrete to imbed these is to be done under Item 200 of this contract.)

Locating the housings on the supports;

Bolting the housings thereto;

Assembling all parts necessary for a complete finished structure which have not previously been assembled at the factory.

In addition to the current transformers to be furnished under this item and specified hereinafter in the description of the oil switches, the Contractor shall mount on each of three of the housings in each land ventilation buildings three G. E. current transformers, type W-15, 4000/5 amperes, which will be furnished and delivered under another contract. This may necessitate making these three housings in each building specially wide to accommodate the transformers.

The work of installation shall be done with the greatest of care to insure that when completed all housings shall be identical and that any truck will fit any housing.

Grounding bus.

The Contractor shall ground at two points the ground bus in each switch bank. For this purpose a ground cable will be furnished projecting from the floor concrete at a point near the ground bus.

Transformer mountings.

207-5. The distribution transformers shall be mounted in steel housings, to be furnished by the Contractor, placed directly above the 2,300 volt oil switch housings to be erected by him under Item 206 of this contract.

Location of transformers.

207-6. The Contractor shall furnish and install twenty-eight (28) of these transformers and housings, five (5) in each land ventilation building and nine (9) in each river ventilation building. All shall be of the dry type.

Potential transformers.

207-7. Two (2) of the potential transformers in each land ventilation building shall be of 200 watt capacity, primary voltage 2,400, secondary voltage 120, suitable for the operation of relays.

All other potential transformers shall be suitable for operating the contactors on the motor starting cabinets. One transformer shall furnish the necessary current for all the contactors in two cabinets. The normal primary voltage shall be 2,400 volts and the normal secondary voltage 240 volts. The closing current of a contactor is 6 amperes at 15% power factor and the holding current 0.6 ampere at 50% power factor. The transformer shall be able to supply a current of 12 amperes at 15% power factor continuously or 22 amperes for ten seconds. Transformers shall be capable of operating for an indefinite period at 2,400 volts without dangerous overheating. At 2,000 volts primary, the voltage variation between no load and 22 amperes, at 35% power factor, shall not exceed 3%. The voltage requirements under these conditions may necessitate a transformer of higher rating than is called for by normal load conditions. Primary connections shall be made as directed on the line side of the current transformers mounted on the housing. Secondary connections shall be made to the terminal board on the housing.

All transformers shall be complete with fuse and support. Each shall have two 5%, low voltage taps on the high side.

Potential transformers shall be able to withstand a potential of twice normal voltage, plus 1,000 volts, for a period of one (1) minute.

Between 80% and 120% voltage, with a secondary load of from 0% to 100%, at a power factor of from 100% to 50%, the ratio of transformation shall be correct within plus or minus 1.5%. Under the same load conditions, the phase angle between primary and secondary voltage shall be 180 degrees plus or minus not more than 20 minutes.

Transformer housings.

207-8. The housings shall completely enclose the transformers. They shall be of steel not less than one-eighth (⅛) inch thick and the front surface shall have a black marine finish and be provided with two doors to give access to the interior. In appearance they shall match up with the oil switch cabinet over which they are mounted. The dimensions shall be as shown on the drawings. The housing shall include a finish strip to cover the joint between adjacent housings.

Wiring of transformer housings.

207-9. The wiring of the transformer housing shall include primary connection to the incoming cables near the base of the switch housing and secondary connections to the terminal board near the floor board.

440 volt oil switches.

207-10. The 440 volt oil switches covered by these specifications shall be 3-pole, power operated, of the truck type, and shall consist of two parts, the movable steel frame on wheels, on which is mounted the oil switch proper and the movable parts of the disconnecting contacts for the main and auxiliary circuits, and the truck housing or stationary part erected in the building, on which are mounted the busbars, current and potential transformers and the stationary parts of the disconnecting contacts for them.

Equipment to be furnished.

207-11. All main and secondary switches, solenoids, main and auxiliary contacts, closing relays, busbars, insulators, current transformers, potential transformers, fuses, resistors, mechanical interlocks, operating mechanisms, levers, fixed and movable partitions, special tools, and auxiliary wiring necessary for the switch or normally mounted on the housings, and truck frames shown on the drawings, shall be furnished as part of this contract, unless specifically stated to the contrary.

Relays.

207-12. The relays for the operation of these and other switches and for all equipment shall be provided and installed under this contract, but, with the exception of the closing relays, shall not be mounted on the truck. These relays are covered elsewhere in this contract. Payment for closing relays will be made under Schedule Item 207 and payment for the other relays will be made under Schedule Item 200.

Dimensions of switches.

207-13. The dimensions of the complete switch shall be such that it can be erected in the space available as shown on the drawings, and that when the truck is withdrawn for ordinary maintenance and inspection there will be ample space for this purpose without turning the truck or moving it to another part of the building. The height of the bank with superstructure shall be not more than the dimensions shown on the drawings.

As shown on the drawings, in the New Jersey land ventilation building, the Contractor shall furnish a steel box on the top of the housings to protect the incoming cables. Control cables shall be separated from 440 volt power cables by steel partitions. These boxes shall be made of one-eighth (⅛) inch steel.

Switch trucks.

207-14. The trucks shall line up with each other and shall fit closely in the structure so as to give a finished, attractive appearance. The construction shall be such as to hide minor irregularities.

Arrangement of switches.

207-15. The switches shall be arranged in two tiers, one vertically above the other. With the switches shall be furnished, in each of the two land ventilation buildings, a movable carriage to permit withdrawing the upper truck for inspection and maintenance, also two temporary doors to close a compartment when the door has been withdrawn.

Switch housing.

207-16. The stationary frame or housing shall be a strongly braced steel structure, with members riveted, bolted or welded together, and covered on top, bottom, back and sides with steel sheeting, so as to entirely enclose the live parts mounted therein as well as the truck

frames. It shall be made in units, each unit to accommodate four trucks, two above and two below, and with a superstructure for carrying potential or contactor supply transformers. The compartments for the four trucks and for the potential transformers shall be separated by steel partitions. The vertical partitions in a unit shall be removable so as to facilitate access to the interior in case repairs are necessary. The horizontal partition between the upper and lower switches shall be of such design as to prevent leakage of oil from the top into the bottom compartments, even if covered with oil to a depth of 1 inch. On the front or back surface a drip shall be furnished which will permit oil spilled on the partition to drip to the floor free of the truck beneath it. The sidewalls of the unit shall provide a double steel wall between adjacent units, not less than one-quarter (¼) inch thick. All other partitions shall be of steel not less than one-eighth (⅛) inch thick.

There shall be a fixed vertical partition to separate the 440 volt wiring from the busbars and terminals.

Potential transformers.

207-17. Mounted above each bank, each in its own superstructure, shall be fifteen (15) transformers, suitable for 60 cycles, primary voltage 440, a total of thirty (30) for the contract.

Six (6) of them shall be for relays and for indicating purposes and shall be of 200 watt capacity, 110 volts secondary.

All other transformers shall be suitable for operating the contactors on the motor starting cabinets. One transformer shall furnish the necessary current for all the contactors in two cabinets. The normal primary voltage shall be 460 volts and the normal secondary voltage 230 volts. The closing current of a contactor is 6 amperes at 15% power factor and the holding current 0.6 amperes at 50% power factor. The transformer shall be able to supply a current of 11 amperes at 15% power factor continuously, or 22 amperes for ten seconds. Transformers

shall be capable of operating for an indefinite period at 480 volts without dangerous overheating. At 400 volts primary, the voltage variation between no load and 22 amperes, at 40% power factor, shall not exceed 3%. In all other respects the transformers shall comply with the requirements of section 207-7. The voltage requirements under these conditions may necessitate a transformer of higher rating than is called for by normal load conditions. Primary connections shall be made as directed on the line side of the current transformers mounted on the housing. Secondary connections shall be made to the terminal board on the housing. Transformers shall have two 5%, low voltage taps on the high side.

Potential transformers.

Instrument potential transformers on the 440 volt service shall be of the dry type for indoor service, rated primary voltage 460, 60 cycles, ratio of transformation 4 to 1 or 2 to 1 as specified hereinbefore. They shall be complete with primary fuse and fuse support and provided with current limiting resistors and device which will permit the fuses to be removed safely.

Truck rails, etc.

207-18. The rails of the truck shall be carried on the steelwork of the structure and shall provide a level runway, insuring a perfect fit of the movable and fixed disconnecting contacts. The rails shall be carried sufficiently far forward that the upper truck may be moved forward to the test position without removing it from the housing. The frame shall be entirely self-supporting and shall carry all supports for insulators, bus bars, current transformers and potential transformers. No dependence shall be placed on adjacent walls or other parts of the building for this purpose. The busses shall be of solid copper capable of carrying continuously 600 amperes, and insulated for 2,500 volts. Spacing between bus bars and between disconnecting contacts on the line side shall be not less than three (3) inches. There shall be clear space between bus bars and ground of not less than two (2) inches. There shall be insulating fireproof barriers between bus bars and between all bare current carrying parts. Bus bar supports and all parts of the structure

shall be able to withstand the mechanical stresses caused by a short circuit of 20,000 amperes.

Potential transformers shall be mounted in a superstructure over the oil switch compartment, back of latched doors. The doors shall be even with the front of the housing.

Contacts, terminals, etc.

Mounted on the housing shall be the 6 main disconnecting contacts and 20 auxiliary contacts for the operating and indicating circuits. Certain of these contacts shall be arranged to make circuit when the truck is not in position, and to break this circuit and make a second circuit on the truck when the latter is moved into the operating position. The contacts shall be so arranged that this second crcuit is made before the first is broken or vice versa. As directed by the Engineer, some of the contacts shall make before the test position is reached. These contacts and all wiring therefor shall be separated from all 440 volt parts by a steel barrier. The wires shall be brought along the back of the housing, accessible from the back of the bank by two or more removable steel doors on hinges. They shall terminate in suitable terminal boards at the bottom of the housing, accessible from the back. Terminals shall be separated from each other by insulating partitions and shall be covered. They shall be of the type manufactured by the Burke Electric Company, or approved equal. Terminals shall be numbered in a permanent manner, the numbers to be assigned by the Engineer. Housings shall be delivered in place with all wiring complete.

Types of housings.

207-19. Housings shall be provided for four different circuits. Type I shall be suitable for the main power transformer circuits. Mounted therein shall be three current transformers, G. E., type W-15, 4000/5 amperes, which will be furnished under another contract, but shall be mounted under this contract. Type J shall be suitable for the feeder circuits. Mounted therein shall be two current transformers. The current transformers shall be of the following capacities:

4 of 150/5;
9 " 60/5;
16 " 50/5;
15 " 40/5.

Type K shall be suitable for a bus sectionalizing switch. No current transformers shall be mounted thereon. Type L shall be suitable for feeding the bus from the 2,300 to 440 volt transformer banks to be furnished under this contract. Mounted on the housing shall be two current transformers of 150/5 amperes. In one bank there shall be three (3) of type I, twenty-two (22) of type J, four (4) of type K and three (3) of type L.

Current transformers.

Current transformers, under conditions of open secondary circuit, shall be capable of carrying continuously rated primary current without damage to the primary insulation and without interruption to the service. Under conditions of closed secondary circuit, current transformers shall be able to withstand the thermal as well as the mechanical stresses resulting from the passage of 6,050 amperes for one (1) second without injury. From 20% to 100% of rated current and for a secondary load of from 0% to 100% at a power factor of from 100% to 50%, the ratio of the transformers shall be correct within plus or minus 1.5%. Under the same load conditions, the phase angle between primary and secondary current shall be 180 degrees plus or minus not more than 45 minutes.

The current transformers shall be suitable for the operation of relays and ammeters. They shall be of the "wound" type, rated at 4,500 volts.

Current transformers shall be able to withstand two and one-quarter times the rated voltage, plus 2,000 volts, for a period of one (1) minute.

Ground busses.

207-20. Two (2) ground busses, one on each tier, shall be furnished, extending the length of each switch bank. They shall be of bare copper bar two (2) inches by one-quarter (¼) inch, located in the back of the compartment. The Contractor shall connect these busses to the

two ground cables to be installed in the floor under another contract.

Test voltage.

207-21. After erection, but with trucks withdrawn and instrument transformers disconnected, all normal live 440 volt parts shall be able to withstand a potential of 5,000 volts for one (1) minute between any two phases or between any phase and ground.

Truck frame.

207-22. The truck frame shall be a strongly braced steel structure with members riveted, welded or bolted together, covered on the front with a steel panel not less than one-eighth (⅛) inch thick and on the back with steel not less than thirty-five one-thousandths (0.035) inch thick. The back plate shall form a gas-tight barrier around the insulators to prevent the escape of hot or ionized gases to the busses. The truck shall be mounted on wheels suitable for rolling on concrete floors as well as on the rails in the compartment.

Truck operating mechanism.

207-23. The truck shall be provided with a suitable mechanism for forcing it into the operating position and for removing it therefrom. The design shall be such that this work can be done by a single switchroom operator without the help of another man. A suitable interlock shall be provided so that, from the time the operating area of the contact is reduced twenty-five per centum (25%) until the clearance between main contacts on the truck and on the stationary housing is two and one-half (2½) inches or more, the oil switch cannot be operated mechanically or electrically. For the purposes of these specifications the latter is termed the test position. The interlocking features shall be such that the truck cannot be moved from or moved into the operating position unless the oil switch is open. This interlock will be tested electrically as well as manually, and after repeated tests shall show no signs of bending or breaking or other indications of failure. The design shall be subject to approval by the Engineer. A stop shall also be furnished to hold the truck in the test position. There shall be a

catch on the truck to hold it in the operating position to prevent it being blown out by an explosion in the switch in the same or an adjacent compartment.

Hand tripping and closing.

207-24. Facilities shall be furnished for hand tripping and closing the oil switch when the truck is in the operating position or in the test position. Suitable guards shall be furnished to prevent accidental operation of the tripping mechanism.

Auxiliary contacts.

207-25. On the top of each truck frame shall be provided a total of twenty (20) auxiliary disconnecting contacts for the operating and indicating circuits, to engage with similar contacts on the frame, as hereinbefore described, when in the operating position. Means shall be provided for making contact, for the purpose of tests, when the truck is in the testing position. These contacts and all wiring therefor shall be separated from all high voltage parts by a steel barrier.

Temperature rise.

207-26. All contacts shall be self-aligning and shall have a temperature rise not exceeding 30° C. above 40° C. ambient when carrying continuously their rated current load.

Oil switches.

207-27. Mounted on the truck shall be a 3-pole oil switch, suitable for controlling a 3 phase, 60 cycle, 440 volt circuit. This shall have an interrupting capacity of 20,000 amperes at 600 volts, a rated capacity of 600 amperes continuously and a 5 second capacity of 20,000 amperes. It shall be able to withstand a potential test of 2,200 volts for one (1) minute. The tanks shall be grounded and the switch shall close against gravity.

The interrupting capacity of the oil switches shall be as recommended in the report of the Electrical Apparatus Committee of the National Electric Light Association for the year 1924, the operating duty to consist of two unit operating cycles separated by a two-minute interval (the so-called OCO-OCO duty).

(a) Mechanical—Inspection after the test shall show the oil switch to be substantially in the same mechanical condition as at the beginning.

(b) Electrical—Inspection after the test shall show the main current carrying parts of the oil switch to be in substantially the same condition as at the beginning. However, the interrupting ability of the oil switch may be materially reduced.

Secondary switches.

207-28. On the truck frame actuated by the oil switch operating mechanism shall be ten (10) sets of secondary switches which shall control ten (10) separate circuits. These shall be arranged separately to open or close with the oil switch, or vice versa. The design shall permit easy change from normally closed to normally open or vice versa at any time after installation.

Electric operation of oil switches.

207-29. Oil switches shall be suitable for operation by direct current from a storage battery or generator. The closing and tripping coils shall operate successfully with a voltage variation of 90 to 140 volts and 70 to 140 volts, respectively.

Connections between the switch and main contacts.

207-30. All connections between the switch and the main disconnecting contacts shall have a continuous carrying capacity of not less than 600 amperes. They shall be separated from ground by not less than one and one-half (1½) inches and from other phases by not less than two and one-half (2½) inches. At the switch terminals, this distance may be decreased if satisfactory insulating partitions are provided. In addition, they shall be insulated with varnished cambric tape of suitable thickness for 2,500 volt service and covered with fire resisting tape. With the truck completely assembled, all normal 440 volt parts shall be able to withstand a test potential of 2,200 volts for one (1) minute.

Interlocks.

207-31. Certain of the oil switches, one of which is placed vertically above the other, as indicated on the drawings, shall be interlocked with each other mechan-

ically in such a way that both cannot be in the closed position simultaneously. The lock shall be of such a type that when one switch is closed it interposes a positive bar to the movement of the other switch and any attempt to close the other switch electrically or manually will have no effect in forcing the closed switch open. It shall be strong mechanically and when tested shall neither bend nor break. The provisions of these specifications, that all trucks shall be interchangeable, apply to the parts normally carried on the trucks required for interlocking. The design shall be subject to the approval of the Engineer.

Ground contact.

207-32. Mounted on the truck shall be a finger or other suitable contact which will engage the ground bus and ground the truck when the truck is in the operating position. The ground shall make contact when the clearance on the main contacts is two (2) inches or less.

Truck wiring.

207-33. Truck wiring, including all main and auxiliary connections for the operating and indicating circuits, shall be finished completely in the factory.

Trucks to be interchangeable.

207-34. All trucks shall be identical and interchangeable.

Switch truck rails.

207-35. The carriage for removing the upper oil switch shall run on rails buried in the floor, parallel with the switch bank. Rails shall be provided on the upper platform to register with rails in the housing so as to permit withdrawing the truck from the housing. Index and locking devices shall be provided to fasten the carriage in the correct position before a truck. The carriage wheels shall be suitable for running either on the rails or on the concrete floor. The design shall be such as to permit the removal of the switch tank for maintenance purposes without lowering the truck to the floor.

Housing mountings.

207-36. The housings shall be mounted on angles or channels in the floor which shall be furnished and installed by the Contractor. They shall be placed with extreme accuracy to provide suitable support for the truck

housings. The Contractor shall provide the necessary rails complete with anchor bolts for the carriage.

Payment, 440 volt oil switches and control transformers.

207-37. Payment for 440 volt oil switches and control transformers will be made at the lump sum price stipulated in Schedule Item 207, which price shall be in full compensation for furnishing and installing the oil switches and transformers in accordance with the drawings and as herein specified, complete, and all expense in connection therewith or incidental thereto except for certain relays which will be paid for under Schedule Item 200 as specified in paragraph 207-12.

CHAPTER V.

SECURITY TO BE FURNISHED BY THE CONTRACTOR.

Contractor's bond.

ARTICLE XXXIV.—Simultaneously with the execution of this contract the Contractor shall give security for the performance of his obligation by filing two bonds, one with the Comptroller of the State of New York, and one with the New Jersey Interstate Bridge and Tunnel Commission, each in the form annexed hereto and entitled "Form of Contractor's Bond," executed by the Contractor and by two or more sureties to be corporations or persons approved by the Commissions, and the bond to the State of New York shall be in the sum of One hundred thousand dollars ($100,000) and the bond to the New Jersey Interstate Bridge and Tunnel Commission shall be in the sum of One hundred thousand dollars ($100,000). The execution of these bonds must be duly proved before their delivery in form essential to proof to entitle a deed to record in the State of New York or in the State of New Jersey and full affidavits of justification of the sureties must be added. In case any of the sureties upon the bonds shall become insolvent or unable in the opinion of the Commissions to pay promptly the amount of such bonds to the extent to which such surety might be liable, then the Contractor within ten (10) days after notice by the Commissions to the Contractor shall, by supple-

mental bonds or otherwise, substitute another and sufficient surety approved by the Commissions in place of the surety so insolvent or unable. If the Contractor shall fail within such ten (10) days or such further time, if any, as the Commissions may grant to substitute another and sufficient surety, then the Contractor shall, if the Commissions so elect, be deemed to be in default in the performance of his obligations hereunder and upon the said bonds, and the Commissions in addition to any and all other remedies may terminate this contract or may bring any proper suit or proceeding against the Contractor and the sureties or either or them or may deduct from any moneys then due or which thereafter may become due to the Contractor under this contract the amount for which the surety insolvent or unable as aforesaid shall have justified on the bonds, and the moneys so deducted shall be held by the Commissions as collateral security for the performance of the condition of the bonds.

Retained percentage may be held pending satisfaction of claims.

ARTICLE XXXVIII.—If at any time when the Contractor shall otherwise be entitled to the payment of all or a part of the retained percentage provided for under Article XL, there shall be pending any claim for injury or alleged injury to person or property occurring or alleged to have occurred on account of the work hereunder, whether by reason of the negligence, fault or default of the Contractor or otherwise or any claim or infringement or alleged infringement of patents, or any claim resulting from the non-payment of labor or material, or any other claim on account of any neglect, fault or default or alleged neglect, fault or default of the Contractor including any claim mentioned in Article LIII for which it shall be claimed that the States or the Commissions or either of them shall be liable, then and in that event the said deposit, bonds or retained percentage, including all interest, dividends and other income thereafter accruing thereon, or such part thereof as the Commission may prescribe shall, upon the requirement of

either Commission, be reserved by the said Comptroller or the said Commission, as the case may be, as security against such claim for a time not exceeding the time when such claims would be legally barred. If and when the liability of the States or the Commissions or either of them on such claim or claims shall have been established by a judgment of a court of competent jurisdiction or such claim or claims shall have been admitted by the Contractor to be valid, the amount of such claim or claims may be deducted from the said retained percentage, before payment thereof shall be made to the Contractor.

Retained percentages.

ARTICLE XL.—In addition there shall be deducted, as hereinafter provided, ten per centum (10%) of the amounts certified from time to time to be due to the Contractor which shall be held as further security for the faithful performance by the Contractor of all the conditions, covenants and requirements specified and provided for in this contract.

The payment of the retained percentage at any time shall be subject to the provisions of Article XXXVIII. The Contractor may from time to time withdraw portions of the amounts so retained upon depositing with the Comptroller or Comptrollers bonds or other acceptable securities which are lawful for the investment of funds of savings banks within the State of New York or the State of New Jersey, as the case may be, and shall be approved by the Commissions. All securities when deposited must be payable to, or run in favor of or be transferred to the Comptroller of the State of New York or the New Jersey Interstate Bridge and Tunnel Commission, as the case may be. In case any of the securities so deposited shall, in the opinion of the Commission in question at any time cease to be of the character of securities which are lawful for the investment of the funds of savings banks within the State of New York or the State of New Jersey, as the case may be, or shall in the opinion of the Com-

missions, or either of them as the case may be, at any time become of less value than the value stated for it or them in the schedule, then within ten (10) days after notice to the Contractor of the objection of the Commission the Contractor shall either substitute therefor securities which shall be approved by the Commission as of the character aforesaid and as being of at least the value of the former securities to which the Commission shall have objected as such value was originally stated in the said schedule or shall deposit with the Comptroller of the State of New York or the New Jersey Interstate Bridge and Tunnel Commission, as the case may be, in cash the amount of such value of such former securities as so originally stated. In case the Contractor shall not within said ten (10) days or such further time, if any, as the Commission may grant, substitute such new securities or make such deposit of cash, the Commission may require the Comptroller to deduct from any moneys then due or which thereafter may become due to the Contractor under this contract the amount of the original valuation of such securities objected to; and the Commission shall hold the moneys so deducted in lieu of such securities as if part of the original deposit as aforesaid. The securities so objected to shall upon such substitution of securities or deposit of cash in lieu thereof be returned to the Contractor.

The Comptroller of the State of New York and the New Jersey Interstate Bridge and Tunnel Commission shall from time to time collect all interest, dividends and other income on any securities deposited by the Contractor and shall pay the same when and as collected, to the Contractor. If the securities are in the form of coupon bonds, the coupons, as they respectively become due shall be delivered to the Contractor. Said bonds, securities and cash deposit shall be subject to the same provisions as the retained percentage.

CHAPTER VI.

PAYMENTS TO CONTRACTOR.

Partial payments

ARTICLE XLI.—In order to assist the Contractor to prosecute the work advantageously, the Engineer shall, from time to time, as the work progresses but not oftener than once a month, make in writing an estimate, such as in his opinion shall be just and fair, of the amount and value of the work done and materials furnished by the Contractor according to the terms of this contract, provided, however, that estimates may at any time be withheld or reduced, if in the opinion of the Engineer, the work is not proceeding in accordance with this contract, or the Contractor is not complying with all of his obligations thereunder. The first such estimate shall be of the amount and value of the work done and materials furnished since the Contractor commenced the performance of this contract on his part. Every subsequent estimate except the final estimate shall be of the amount and value of the work done and materials furnished since the last preceding estimate was made, provided, however, that no such estimate shall be required to be made when, in the judgment of the Engineer, the total value of the work done and materials furnished since the last preceding estimate amounts to less than Five thousand dollars ($5,000).

Not by strict measurement.

ARTICLE XLII.—Partial estimates shall not be required to be made by strict measurement, but they may be made by measurement or by estimation, or partly by one method and partly by the other, and it shall be sufficient if they are approximate only.

Vouchers.

ARTICLE XLIII.—When each partial estimate is made and certified by the Engineer in writing to the Commissions, the respective Commissions shall prepare and certify one voucher each for forty-five per centum (45%) of the amount stated in such estimate or certificate of the value of the work done and materials furnished, each

Commission retaining five per centum (5%) of each partial estimate.

The States shall, within thirty (30) days after the date of the certification of such vouchers by the Commissions, pay the same; provided, however, that the States, or either of their Commissions, may at all times reserve and retain from said partial estimates or any of them, in addition to all deductions above mentioned, any sum or sums which, by the terms hereof or of any law of the State of New York or the State of New Jersey is or may be authorized to be reserved or to be retained.

Final payment.

ARTICLE XLIV.—Whenever, in the opinion of the Engineer, the Contractor shall have completely performed this contract on his part and no further work shall be required of him hereunder, the Engineer shall so certify in writing to the Commissions and in his certificate shall state from actual measurements the whole amount of the work done by the Contractor and also the value of such work under and according to the terms of this contract. On the expiration of forty (40) days after the acceptance by the Commissions of the work herein agreed to be done by the Contractor and the filing of a Certificate of the completion and acceptance of the work in the office of the Commissions, signed by the Engineer and the Chairman of each Commission, the Commissions shall cause to be paid to the Contractor the amount remaining after deducting from the amount stated in the last-mentioned certificate all such sums as shall heretofore have been paid to the Contractor under any of the provisions of this contract and also any sum or all such sums of money as by the terms hereof the States are or may be authorized or required to reserve or retain; provided that nothing herein contained shall be construed to affect the right, hereby reserved, of the Commissions to reject the whole or any portion of the aforesaid work, should the said certificate be found or known to be inconsistent with the terms of this contract or otherwise improperly

given. All prior certificates upon which partial payments may have been made, being merely estimates, shall be subject to correction in the final certificate, which final certificate may be made without notice thereof to the Contractor or of the measurement upon which it is based.

Interest on delayed payments.

ARTICLE XLV.—If the payment of the amount due the Contractor on any voucher shall be delayed beyond the time stipulated in Article XLIII in the case of partial payment, or Article XLIV in the case of final payment, the State whose voucher is delayed shall pay the Contractor interest on such amount at the rate of six per centum (6%) per annum for the period of such delay; it being understood that such payments of interest, if any, are to be in lieu of any claim of the Contractor for alleged damages for breach of contract or otherwise in case of delayed payments. The term for which interest shall be paid shall be reckoned, in the case of a partial payment from the thirtieth day after the certification of such voucher by the Commission, and in case of final payment from the fortieth day after the acceptance of the work by the Commissions to date of payment of the voucher. The date of payment of a voucher shall be considered the day on which the voucher is ready for payment as evidenced by the records of the Comptrollers of the State of New York and the State of New Jersey. If interest shall become due on any partial payment, the amount thereof shall be added to a succeeding payment by the Commission delaying such payment. If interest shall become due on a final payment, the amount thereof shall be paid on a supplementary voucher prepared by the Commission delaying such payment.

No estoppel.

ARTICLE XLVI.—The States shall not, nor shall any department or officer thereof, be precluded or estopped by any return or certificate made or given by the Commissions, the Engineer or other officer, agent or appointee thereof under any provision of this contract,

from, at any time either before or after the final completion and acceptance of the work and payment thereof pursuant to any such return or certificate, showing the true and correct amount, quality and character of the work done and materials furnished by the Contractor or any other person under this contract, or from showing at any time that any such return or certificate is untrue and incorrect or improperly made in any particular or that the work and materials or any part thereof do not in fact conform to the specifications; and the States shall not be precluded or estopped, notwithstanding any such return or certificate and payment in accordance therewith, from demanding and recovering from the Contractor such damages as they may sustain by reason of his failure to comply with this contract or the specifications.

No waiver.

ARTICLE XLVII.—Neither the acceptance by the Commissions or their Engineer or any of their employees nor any order, measurement or certificate by the Engineer, nor any order by the Commissions for payment of money nor any payment for, nor acceptance of, the whole or any part of the work by the Engineer or the Commissions, nor any extension of time nor any possession taken by the Commissions or their employees shall operate as a waiver of any portion of this contract or of any power herein reserved to the Commissions or of any right to damages herein provided; nor shall any waiver of any breach of this contract be held to be a waiver of any other or subsequent breach.

Final payment to terminate liability of States.

ARTICLE XLVIII.—The acceptance by the Contractor of the last payment aforesaid shall be and shall operate as a release to the States from all claim and liability to the Contractor for anything done or furnished for, or relating to, the work, or for any act or neglect of the Commissions, the States or of any person relating to or affecting the work, except only the claim against the States for the remainder, if any there be, of the amounts kept or retained as provided in this contract.

Contractor's claim for damage.

ARTICLE XLIX.—If the Contractor shall claim compensation for any damages sustained by reason of any act or neglect of the States or the Commissions or their agents, he shall, within ten (10) days after the sustaining of such damage, make a written statement to the Commissions of the nature of the damages sustained. On or before the fifteenth day of the month succeeding that in which any such damage shall have been sustained the Contractor shall file with the Commissions an itemized statement of the details and amount of such damage, and unless such statement shall be made as thus required, his claim for compensation may in the discretion of the Commissions be forfeited and invalidated and he shall not be entitled to payment on account of any such damage.

CHAPTER VII.

CONTRACTOR'S LIABILITY FOR INJURIES TO PERSONS OR DAMAGE TO PROPERTY.

Contractor's liability for damages.

ARTICLE L.—The Contractor expressly admits and covenants to and with the States that the specifications and other provisions of this contract, if the work be done without fault or negligence on the part of the Contractor, do not involve any damage to the tunnel structure, administration buildings or ventilation buildings or any appurtenances thereof, to surface, subsurface or overhead structures, foundations, walls or other parts of adjacent or abutting structures; and the Contractor will at his own expense make good any damage that shall, in the performance of the work, be done to the tunnel structure, administration buildings or ventilation buildings or any appurtenances thereof, to surface, subsurface or overhead structures, foundations, walls or other parts of adjacent or abutting structures. The liability of the Contractor under this covenant is absolute and is not dependent upon any question of negligence on his part or on the part of his agents, servants or employees, and the neglect of the Commissions or their Engineer to direct the Contractor to take any particular precautions

or to refrain from doing any particular thing shall not excuse the Contractor in case of any such damage.

It is the intention of the parties to this contract that, in addition to indemnifying the States against all claims for damages, the Contractor shall also be liable to the owners of adjacent or abutting property, buildings or structures and to all tenants or occupants of such buildings or structures for all physical injuries to property or person which may be occasioned by the work of the construction, even in cases where such owners, tenants or occupants have no legal claim against the States for such injuries.

Indemnification for accidents.

ARTICLE LII.—The Contractor shall be solely responsible for all physical injuries to person or property occurring on account of the work hereunder and shall indemnify and save harmless the States from liability upon any and all claims for damages on account of such injuries to person or property and from all costs and expenses in suits which may be brought against the States for such injuries to person or property; it being distinctly understood, covenanted and agreed that the Contractor shall be solely responsible and liable for and shall fully protect and indemnify the States against all claims for damages to person or property occasioned by or resulting from the methods or process of doing the work, whether such damages be attributable to negligence of the Contractor, of his employees or otherwise.

Money due Contractor may be retained to meet claims.

ARTICLE LIII.—In case any claim shall be made by any person or corporation against the Contractor or the States for injury or alleged injury to person or property occurring or alleged to have occurred on account of the work hereunder, whether by reason of the negligence, fault or default of the Contractor or otherwise, or for any infringement or alleged infringement of patents or for any neglect, fault or default or alleged neglect, fault or default of the Contractor, the amount of such claim

or so much thereof as the Commissions may deem reasonable shall, upon the requirement and in the discretion of the Commissions, be retained by the Commissions out of any moneys then due or thereafter growing due to the Contractor hereunder (in addition to the other sums herein authorized to be so retained) as security for the payment of such claim or claims. If and when the liability of the States or the Contractor on such claim or claims shall have been established by a judgment of a court of competent jurisdiction or such claim or claims shall have been admitted by the Contractor to be valid, the said claim or claims may be paid from the amount so retained and the balance, if any, paid to the Contractor. Should there be any unsatisfied claim or claims for injury or alleged injury to person or property occurring or alleged to have occurred on account of the work hereunder, whether by reason of the negligence, fault or default of the Contractor or otherwise, or for any infringement or alleged infringement of patents or for any neglect, fault or default of the Contractor, at the time when the final voucher for the work is prepared and certified, the Commissions shall have the right to retain out of the final payment and to deduct from the amount of the final voucher a sum in their judgment sufficient to protect the States in regard to all unsatisfied claims as aforesaid, and in case the amount thus retained should be insufficient to pay the amount determined to be due upon such claim or claims, the States may sue for and recover from the Contractor the amount or balance as a debt from the Contractor to the States. The Commissions may further, if in their judgment such a course is necessary or proper, at the time of preparing and certifying the final voucher and as a condition of preparing and certifying the same, require the Contractor to continue his bond or deposit or any part thereof as security against any such unsatisfied claims for a time not exceeding the time when such claim would be legally barred.

Contractor's guarantee of equipment.

The Contractor guarantees all the equipment to be furnished under this contract and its appurtenances and the installation work to be performed under this contract against any defects due to faulty material, workmanship or installation, for a period of one (1) year after the date of the final completion and acceptance of the Works, and the Contractor, promptly, upon notice from the Commissions or their Engineer, shall replace all such defective equipment or installation work and in the event of his failure promptly upon such notice to replace such equipment or installation work, the Commissions or their successors shall have the right to replace the same and charge the expense thereof to the Contractor. The Contractor shall promptly pay all expenses incurred for that purpose. The Contractor shall deposit with the Commissions before the final voucher shall be prepared or certified by the Commissions and before any deposit of cash or security or any part thereof given by the Contractor as security for the purpose of this contract shall be surrendered, a bond or bonds to the Commissions or their successors in such form as the Commissions shall require and duly executed and acknowledged in the sum total of Fifty thousand dollars ($50,000) with two or more sureties of persons or corporations approved by the Commissions, conditioned on the faithful performance of the work and of all the obligations under this paragraph.

Damage to Works during construction.

ARTICLE LV.—All risk of loss or damage to the Works or to any part thereof or to any of the materials, plant, tools, appliances, supplies or other things used in doing the work prior to final completion is assumed and shall be borne by the Contractor, and any such loss or damage shall be made good by the Contractor at his own cost, and the work shall be carried forward by him in accordance with this contract without additional cost to the States by reason of such loss or damage.

Claim for infringement of patents.

ARTICLE LVI.—The Contractor shall be responsible for any claims made against the States for any infringe-

ments of patents by the use of patented tools, articles or appliances in the performance or completion of the work, or by the use of any materials, process or method connected with the work, and he shall save harmless and indemnify the States from and against all costs, expenses and damages which the States shall be obliged to pay by reason of any such use or infringement.

CHAPTER VIII.

STATES TO SECURE CONTRACTOR AGAINST INTERFERENCE BY INJUNCTIONS.

Right of Contractor to perform stipulations of contract.

ARTICLE LVII.—The Commissions hereby covenant and agree to and with the Contractor that they will use their best endeavor to secure and assure to the Contractor, so long as the Contractor shall perform the covenants of this contract, the right to furnish and install the electrical equipment in the Tunnel as prescribed in this contract, free of all right, claim or other interference, whether by injunction, suit for damages or otherwise on the part of any person; but not including any interference, legal or otherwise, by patentees or persons claiming to be patentees of tools, methods or appliances.

Dates when different portions of Tunnel will be available.

The construction of the ventilation buildings, administration buildings and the entrance and exit plazas of the Tunnel has not yet been completed and the Contractor will have to begin his work in those portions of the Tunnel in which the other contractors have finished. Listed below is a schedule giving the approximate dates when the various portions will become available for the work to be done under this contract:

The tunnels proper, except New Jersey approaches, at once.

The river ventilation building and shafts, New York, September 1, 1926.

The New Jersey plazas, portions by September 1, 1926, the remainder by November 1, 1926.

The New York entrance plaza, portions by October 1, 1926, the remainder by December 1, 1926.

The land ventilation building and shafts, New York, October 1, 1926.

The river ventilation building and shafts, New Jersey, November 1, 1926.

The land ventilation building and shafts, New Jersey, December 1, 1926.

The administration building, New York, January 1, 1927.

The administration building, New Jersey, February 1, 1927.

Hauling and trucking in the Tunnel.

Any hauling or trucking of material, supplies or equipment into or through the Tunnel shall be done at such times and in such manner and with such vehicles as are approved by the Engineer.

CHAPTER IX.

TIME FOR COMPLETION, DAMAGES FOR DELAY, ETC.

Commencement and completion of work.

ARTICLE LXI.—Time is of the essence of this contract. The Contractor shall begin actual work within fifteen (15) days after the date of the delivery of the contract and shall henceforth prosecute the work continuously and diligently. The entire work covered by this contract shall be completed in all respects within seven (7) months from the date of the delivery of the contract.

Damage for delay.

ARTICLE LXII.—In the event of delay in completion of any work ordered hereunder beyond the period herein prescribed or beyond the period to which such time may be extended by resolution of the Commissions for good cause shown, the States shall be paid damages for such delay. Inasmuch as the amount of such damages will be extremely difficult to ascertain, especially in view of the fact that the furnishing and installing of the Electrical Equipment in the Tunnel is a part of the construction of the Holland Tunnel and that any delay in the furnish-

ing and installing of the Electrical Equipment in said Tunnel may delay the construction and completion of said Holland Tunnel, it is hereby expressly agreed that such damages shall be liquidated and paid as follows:

The Contractor shall pay to the States for each and every day, except Sundays and legal holidays, that he shall be in default in completing the entire work to be done under this contract, the sum of One thousand dollars ($1,000), which sum is hereby agreed upon not as a penalty but as liquidated damages which the States will suffer by reason of such default. The States shall have the right to deduct such amounts from any moneys due or which may thereafter become due to the Contractor under this contract. But in case the Contractor shall be actually and necessarily delayed by reason of any injunction or by any interference of public authority or by the suspension of the work by the Commissions as provided in Article LXV, and in case the Contractor cannot with reasonable diligence make up for the delay so occasioned by speedier work when the Contractor shall not so be delayed, then the said date for completion shall, except as hereinafter provided, be extended by resolution of the Commissions to a date later than the expiration of the said period of seven (7) months by the amount of the time of such delays as determined by the Commissions.

Commissions may intervene in case of injunctions.

ARTICLE LXIII.—No injunction or interference of public authority shall be ground for such extension unless and until the Contractor shall give the Commissions notice of the injunction or other cause of delay, with copies of the injunction or other orders and of the papers upon which the same shall have been granted, and no extension shall be granted except for the delay occasioned after the giving of such notice. Nor will any extension be granted in any case unless the Contractor shall prove to the satisfaction of the Commissions all the facts which entitled him to such extension. The Commissions and the States or either shall be accorded the right

to intervene or become a party to any suit or proceeding in which any such injunction shall be obtained and to move to dissolve the same or otherwise, as the Commissions or the States may deem proper. If required by the Commissions, counsel to the Commissions shall be authorized by the Contractor to appear for that purpose as counsel or attorneys for him.

Suspension of work.

ARTICLE LXV.—The Commissions reserve the right of temporarily suspending the execution of the whole or any part of any work ordered to be performed hereunder, if they shall deem it for the interest of the States so to do, without compensation to the Contractor for such suspension other than extending the time for completing the work as hereinbefore provided as much as it may have been delayed by such suspension.

Extensions not cumulative.

ARTICLE LXVI.—Only the actual delay necessarily resulting from one or more of the causes above mentioned shall be ground for extension of time, and in case the Contractor shall be delayed at any time or for any period by two or more of the causes above mentioned, only one period of extension, if any, shall be granted for such delay and the Contractor shall not be entitled to a separate extension for each one of the causes so operating, it being understood that only the actual period of necessary delay, as determined by the Commissions, irrespective of the number of causes contributing to produce such delay, will be ground for extension of time.

Permission to complete contract, no waiver.

ARTICLE LXVII.—Permission to the Contractor to proceed with and finish the work or any part of it after the time fixed for its completion or after the date to which the time for completion may have been extended, or the making of payments to the Contractor after any of such periods, shall in nowise operate as a waiver on the part of the States of any of their rights under this contract.

CHAPTER X.

REMEDIES IN CASE OF CONTRACTOR'S DEFAULT.

In cases of default.

ARTICLE LXVIII.—If any work to be done under this contract shall be abandoned by the Contractor, or if this contract shall be assigned or the work sublet by him otherwise than as herein specified, or if the Contractor shall not comply with such orders as may from time to time be given by the Commissions or the Engineer with respect to the work, or if the Contractor shall violate any of the provisions or covenants of this contract or of the specifications, or shall not execute the same in good faith and in accordance with the terms hereof, or if at any time the Engineer shall certify in writing to the Commissions that in his opinion suitable and sufficient materials, plant, power, tools, supplies or other means of construction are not provided, or that a sufficient number of workmen are not employed in the execution of the work under this contract, or that in his opinion the work or any part thereof is not being carried on with such skill, diligence and dispatch as will insure the completion of the work within the time specified in this contract, or if any work be not fully completed within the time named in this contract for its completion or within the period to which the time for completion may be extended by the Commissions or (in view of the necessity for special skill and ample financial resources in the prosecution of the work), if the Contractor shall become insolvent or bankrupt or if his property or affairs shall be put in the hands of a receiver or receivers, then and in any of such cases the Commissions may upon not less than five (5) days' notice to the Contractor or upon such shorter notice as in the opinion of the Commissioners may be justified,

(1) Declare the Contractor to be in default; and the Commissions may thereupon notify the Contractor, by a written notice, to discontinue all work or any part thereof under this contract, and thereupon the Contractor

shall discontinue the work or such part thereof, and the Commissions shall thereupon have the right, either for the Contractor, for his account and at his risk, or otherwise as the Commissions may determine, to contract for the completion of the Works or such part thereof, either with or without public advertisement, or to place such and so many persons as they may deem advisable, by contract or otherwise, to work and complete the work herein described or such part thereof, to take possession of and use any or all of the materials, plant, tools, appliances, equipment, supplies and property of every kind provided by the Contractor for the purpose of his work, and to procure other materials, plant, tools, appliances, equipment, supplies and property for the completion of the Works or such part thereof, and to charge the expense of said labor and materials, plant, tools, appliances, equipment, supplies and property to the Contractor. The expense so charged may be deducted and paid by the States out of such moneys as may be due or may at any time thereafter grow due to the Contractor under and by virtue of this contract. And the Contractor shall, upon the completion of the Works or such part thereof or from time to time during the course of the completion of the Works, or such part thereof, as the Commissions may require, forthwith to pay to the States, with interest, the excess, if any, of the cost to the States of the completion of the Works or such part thereof over the amount payable to the Contractor for the same work and materials under the terms of this contract. And the completion of the Works or such part thereof by the Commissions shall not release or discharge the Contractor from liability with respect to the remainder of the work or any other obligation or liability hereunder; and when any particular part of the work is being carried on by the Commissions by contract or otherwise, under the provisions of this paragraph (1), the Contractor, unless he shall have been directed to discontinue all work, shall continue the remainder of the work in conformity with

the terms of this contract and in such manner as in no-wise to hinder or interfere with other contractors of the Commissions or with the persons or workmen employed, as above provided, by the Commissions, by contract or otherwise, to do any part of the work or to complete the same under the provisions of this paragraph. Or

(2) Declare this contract at an end except as to the liability of the Contractor hereinafter in this paragraph provided for; and the Commissions shall thereupon have the right to contract for the completion of the Works, either with or without public advertisement, or to place such and so many persons as they may deem advisable, by contract or otherwise, to work and complete the work herein described, to take possession of and use all the materials, plant, tools, appliances, equipment, supplies and property of every kind provided by the Contractor for the performance of his work and to procure other materials, plant, tools, appliances, equipment, supplies and property for the completion of the same. And in case the expense to the States of completing the Works (including the expense of procuring such other materials, plant, tools, appliances, equipment, supplies and property) shall exceed the amount which would have been payable to the Contractor for the same work and materials under this contract if this contract had been completed by the Contractor, he shall, upon the completion of the Works or from time to time during the course of the completion of the Works as the Commissions may require, pay the amount of such excess, with interest, to the States; and in case such expense shall be less than the amount which would have been payable to the Contractor for the same work and materials under this contract if this contract had been completed by the Contractor, he shall forfeit all claim to the difference. And the Contractor shall also pay to the States the amount of any claim for which the States shall be liable for injury to person or property occurring on account of any work

done by the Contractor under this contract, whether by reason of the negligence, fault or default of the Contractor or otherwise, or for infringement of patents or for any neglect, fault or default of the Contractor, and shall also pay to the States the amount of any other expense which the States may incur or be liable for, and the amount of any payment which the States may be required to make, and the amount of any loss or damage which the States may incur or suffer, by reason of any neglect, fault or default of the Contractor. Or

(3) The Commissions may require the surety or sureties to perform and complete the Works or such parts thereof as the Commissions may require, under the terms of this contract. Or

(4) The States may also proceed, as to the Commissions shall seem proper, upon the bonds or other security in its possession. And

(5) The States may also bring any suit or proceeding for specific performance or for injunction or to recover damages or to obtain any other relief or for any other purpose proper under this contract.

Engineer's certificate of expense.

ARTICLE LXIX.—In case the Commissions shall by contract or otherwise complete the Works or any part thereof under the provisions of Article LXVIII, the Engineer, upon the completion of the Works or such part thereof or at any time thereafter upon demand in writing by either party hereto or from time to time during the course of the completion of the Works or such part thereof upon demand by the Commissions, shall certify to the amount of the expense incurred by the States in the completion of the Works or such part thereof, and said certificate shall be final and conclusive and admissible in evidence against the Contractor in any litigation arising or growing out of this contract.

States may use all remedies.

ARTICLE LXX.—The States may avail themselves of each and every remedy herein specifically given to the

States or now or hereafter existing at law or in equity, and each and every such remedy shall be in addition to every other remedy so specifically given or otherwise so existing and may be exercised from time to time and as often and in such order as may be deemed expedient by the Commissions, and the exercise, or the beginning of the exercise, of one remedy shall not be deemed to be a waiver of the right to exercise, at the same time or thereafter, any other remedy, except that no two inconsistent remedies shall be exercised at the same time.

IN WITNESS WHEREOF, this contract has been executed by the New York State Bridge and Tunnel Commission, acting for and in behalf of the State of New York, in and by authority of a resolution duly adopted by the Commission, and these presents signed by the Chairman and attested by the Secretary, and by the New Jersey Interstate Bridge and Tunnel Commission, acting for and in behalf of the State of New Jersey, in and by authority of a resolution duly adopted by the Commission and these presents signed by the Chairman and attested by the Secretary, and the Contractor has* (hereunto set his hand and seal) (caused its corporate seal to be hereto affixed and these presents to be executed by its President and attested by its Secretary by virtue of a resolution duly adopted by its Board of Directors) the day and year first above written.

*If the Contractor is an individual, use the words enclosed in the first bracket; if a corporation, use the words enclosed in the second bracket.

TESTIMONIUM

FOR THE STATE OF NEW YORK

NEW YORK STATE BRIDGE AND TUNNEL COMMISSION

By

.....

Chairman

Attest:

.....

Secretary

FOR THE STATE OF NEW JERSEY

NEW JERSEY INTERSTATE BRIDGE AND TUNNEL COMMISSION

By

.....

Chairman

Attest:

.....

Secretary

CONTRACTOR

.....(Seal)

(If corporation, name of corporation)

.....

President

Attest:

.....

Secretary

ACKNOWLEDGMENT

State of New York,
County of New York, } ss.:

On this day of , 1926, before me personally appeared George R. Dyer and Morris M. Frohlich, to me known and known to me to be the said George R. Dyer the Chairman and the said Morris M. Frohlich the Secretary of the New York State Bridge and Tunnel Commission; and the said George R. Dyer and Morris M. Frohlich being by me duly sworn did depose and say each for himself and not for the other; the said George R. Dyer that he resides in the Borough of Manhattan, in the City, County and State of New York; that he is Chairman of the said Commission and that he subscribed his name to the foregoing contract by virtue of the authority thereof; and the said Morris M. Frohlich that he resides in the Borough of Manhattan, in the City, County and State of New York; that he is the Secretary of the said Commission and that he subscribed his name thereto by like authority.

.....

.....

.....

ACKNOWLEDGMENT

State of New York, }
County of New York, } ss.:

On this day of , 1926, before me personally appeared Theodore Boettger and E. Morgan Barradale, to me known and known to me to be, the said Theodore Boettger, the Chairman and the said E. Morgan Barradale the Secretary of the New Jersey Interstate Bridge and Tunnel Commission; and the said Theodore Boettger and E. Morgan Barradale being by me duly sworn did depose and say each for himself and not for the other; the said Theodore Boettger that he resides in the Town of Hackensack, Bergen County, New Jersey, that he is Chairman of the said Commission and that he subscribed his name to the foregoing contract by virtue of the authority thereof; and the said E. Morgan Barradale that he resides in the Village of South Orange, Essex County, New Jersey; that he is the Secretary of the said Commission and that he subscribed his name thereto by like authority.

.....

.....

.....

ACKNOWLEDGMENT

State of New York, }
County of New York, } ss.:

On this day of , 1926, before me personally came to me known and known to me to be the individual described in and who executed the foregoing instrument, and he duly acknowledged to me that he executed the same.

.....

.....

.....

State of New York, }
County of New York, } ss.:

On this day of , 1926, before me personally appeared
to me known, who being by me first duly sworn did depose and say that he resides in
in the State of , that he is the
of
, the corporation described in and which executed the foregoing instrument; that he affixed the corporate seal of said corporation; that one of the seals affixed to said contract is such corporate seal and that it was affixed thereto by order of the Board of Directors of said corporation and that he signed his name thereto by like order.

.....

.....

.....

FORM OF CONTRACTOR'S BOND.

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned,

as principal, and

as sureties, are hereby held and firmly bound unto the New York State Bridge and Tunnel Commission, acting for and in behalf of the State of New York, in the penal sum of One hundred thousand dollars ($100,000) for the payment of which well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

Signed this day of , 1926.

The condition of the above obligation is such that whereas the above named principal did on the day of , 1926, enter into a contract with the New York State Bridge and Tunnel Commission, acting for and in behalf of the State of New York, AND the New Jersey Interstate Bridge and Tunnel Commission, acting for and in behalf of the State of New Jersey, which said contract is made a part of this bond the same as though set forth herein:

Now, if the said

shall well and faithfully do and perform the things agreed by to be done and performed according to the terms of said contract, and shall pay all lawful

claims of subcontractors, materialmen and laborers, for labor performed and materials furnished in the carrying forward, performing or completing of said contract, we agreeing and assenting that this undertaking shall be for the benefit of any materialman or laborer having a just claim, as well as for the obligee herein; then this obligation shall be void; otherwise the same shall remain in full force and effect; it being expressly understood and agreed that the liability of the surety for any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein stated.

The said surety for value received hereby stipulates and agrees that any modifications, omissions, additions, or extensions of time in or to the said contract or in or to the plans and specifications therefor shall in no wise affect the obligations of said surety and its bond and it does hereby waive notice of any such modifications, omissions, additions and extensions.

In Witness Whereof, the Contractor and the Sureties have hereunto set their hands and seals and such of them as are corporations have caused their respective seals to be hereto affixed and these presents to be attested by the proper officers this day of , 1926.

(Affix Sureties' Acknowledgments and Justifications)

CONTRACTOR'S ACKNOWLEDGMENT.

State of .....
County of ..... } ss.:

On this ..... day of ....., 1926, before me personally appeared ....., to me known, who being by me first duly sworn, did depose and say that he resides in ....., in the State of ....., that he is the ..... of ..... the corporation described in and which executed the foregoing instrument; that he affixed the corporate seal of said corporation; that one of the seals affixed to said bond is such corporate seal and that it was affixed thereto by order of the Board of Directors of said corporation and that he signed his name thereto by like order.

Sworn and subscribed to before me the day and year above written.

.....

FORM OF CONTRACTOR'S BOND.

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned,

as principal, and

as sureties are hereby held and firmly bound unto the New Jersey Interstate Bridge and Tunnel Commission, acting for and in behalf of the State of New Jersey, in the penal sum of One hundred thousand dollars ($100,000), for the payment of which well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

Signed this day of , 1926.

The condition of the above obligation is such that whereas, the above named principal did on the day of , 1926, enter into a contract with the New Jersey Interstate Bridge and Tunnel Commission, acting for and in behalf of the State of New Jersey, AND the New York State Bridge and Tunnel Commission, acting for and in behalf of the State of New York, which said contract is made a part of this bond the same as though set forth herein:

Now, if the said

shall well and faithfully do and perform the things agreed by to be done and performed according to the terms of said contract, and shall pay all lawful claims of subcontractors, material-

men and laborers, for labor performed and materials furnished in the carrying forward, performing or completing of said contract, we agreeing and assenting that this undertaking shall be for the benefit of any materialman or laborer having a just claim, as well as for the obligee herein; then this obligation shall be void, otherwise the same shall remain in full force and effect, it being expressly understood and agreed that the liability of the surety for any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein stated.

The said surety for value received hereby stipulates and agrees that any modifications, omissions, additions or extensions of time in or to the said contract or in or to the plans and specifications therefor shall in no wise affect the obligations of said surety and its bond and it does hereby waive notice of any such modifications, omissions, additions and extensions.

In Witness Whereof, the Contractor and the Sureties have hereunto set their hands and seals and such of them as are corporations have caused their respective seals to be hereto affixed and these presents to be attested by the proper officers this day of 1926.

(Affix Sureties' Acknowledgments and Justifications)

CONTRACTOR'S ACKNOWLEDGMENT.

State of .....
County of ..... } ss.:

On this ..... day of ....., 1926, before me personally appeared ....., to me known, who being by me first duly sworn, did depose and say that he resides in ..... in the State of ....., that he is the ..... of ..... the corporation described in and which executed the foregoing instrument; that he affixed the corporate seal of said corporation; that one of the seals affixed to said bond is such corporate seal and that it was affixed thereto by order of the Board of Directors of said corporation and that he signed his name thereto by like order.

Sworn and subscribed to before me the day and year above written.

.....

CONTRACTOR'S PROPOSAL

FOR FURNISHING AND INSTALLING THE ELECTRICAL EQUIPMENT FOR THE HOLLAND TUNNEL.

To the New York State Bridge and Tunnel Commission, acting for and in behalf of the State of New York, and to the New Jersey Interstate Bridge and Tunnel Commission, acting for and in behalf of the State of New Jersey:

(1) The undersigned*

do hereby, in pursuance of the invitation and information for bidders, copies of which are annexed hereto and made a part hereof, propose according to the terms thereof to enter into a contract in the form annexed hereto and made a part hereof with the State of New York and the State of New Jersey (hereinafter called the "States") acting by the New York State Bridge and Tunnel Commission and the New Jersey Interstate Bridge and Tunnel Commission (hereinafter called the "Commissions") for furnishing and installing the Electrical Equipment for the Holland Tunnel and to furnish all necessary labor, materials, plant, power, tools, equipment, supplies and other means of construction and perform all work mentioned in the said contract at the prices for the several items as given in the Schedule of Prices.

* The bidder's name must be inserted here. If the bid is submitted by a corporation, the full legal title must be given here and a certified copy of the certificate of incorporation must be submitted, together with an affidavit showing the amount of stock paid in cash and the names and addresses of the directors and principal officers. If the bidder be a foreign corporation, proof must also be submitted of its authority to transact business in the State of New York and the State of New Jersey. If the bid is submitted by a partnership, the above blank must be filled up in the following form, "the firm of A. B. & Co., composed of A. B. C. D., etc." (giving the names of all the partners).

THE CONTRACTOR'S PROPOSAL
SCHEDULE
*(Bid prices are to be filled out both in writing and in figures.)

Item	Classification	Lump Sum	
		$	c.
195.	For the tunnel lighting, complete, the lump sum of dollars and cents.		
196.	For the New York entrance plaza and New Jersey entrance and exit plaza lighting, complete, the lump sum of dollars and cents.		
197.	For the telephone equipment, complete, the lump sum of dollars and cents.		
198.	For the lighting and electric heating in buildings and shafts including passages, as follows:		
	(a) For the land ventilation building and shafts, New York, the lump sum of dollars and cents.		
	(b) For the river ventilation building and shafts, New York, the lump sum of dollars and cents.		
	(c) For the land ventilation building and shafts, New Jersey, the lump sum of dollars and cents.		
	(d) For the river ventilation building and shafts, New Jersey, the lump sum of dollars and cents.		

*If there are discrepancies between the prices expressed in writing and the prices expressed in figures, the prices expressed in writing will be taken as the bid prices.

THE CONTRACTOR'S PROPOSAL
SCHEDULE
(Bid prices are to be filled out both in writing and in figures.)

Item	Classification	Lump Sum	
		$	c.
199.	For the power and control wiring and lighting transformers in buildings and shafts, as follows:		
	(a) For the land ventilation building and shafts, New York, the lump sum of dollars and cents.		
	(b) For the river ventilation building and shafts, New York, the lump sum of dollars and cents.		
	(c) For the land ventilation building and shafts, New Jersey, the lump sum of dollars and cents.		
	(d) For the river ventilation building and shafts, New Jersey, the lump sum of dollars and cents.		
200.	For the control switchboards, storage batteries and concrete floors in control rooms as follows:		
	(a) For the land ventilation building, New York, the lump sum of dollars and cents.		
	(b) For the river ventilation building, New York, the lump sum of dollars and cents.		
	(c) For the land ventilation building, New Jersey, the lump sum of dollars and cents.		

THE CONTRACTOR'S PROPOSAL
SCHEDULE
(Bid prices are to be filled out both in writing and in figures.)

Item	Classification	Lump Sum	
		$	c.
	(d) For the river ventilation building, New Jersey, the lump sum of dollars and cents.		
201.	For the supervisory system, complete, including a concrete floor in the New York administration building, the lump sum of dollars and cents.		
202.	For four (4) carbon monoxide recorders, complete, the lump sum of dollars and cents.		
203.	For miscellaneous equipment, the lump sum of dollars and cents.		
206.	For installing air blast power transformers and 13,200 volt and 2,300 volt oil switches furnished under another contract, the lump sum of dollars and cents.		
207.	For furnishing and installing 440 volt oil switches and potential and current transformers and for installing current transformers furnished under another contract, the lump sum of dollars and cents.		

(2) If this proposal is accepted, the undersigned will within five (5) days after the delivery of notice attend at the office of the Commissions in person or by duly authorized representatives, and will then and there deliver the contract with the States in the form aforesaid duly executed, and with its execution duly proved; and the undersigned will at the same time deliver to the Commissions pursuant to the terms of said contract *bonds in the sum total of Two hundred thousand dollars ($200,000) in the forms annexed hereto and made a part hereof, with the following named sureties, or, in the event that the following named sureties or any of them shall not be approved by the Commissions with such other sureties as the Commissions shall approve.*

It is understood that the acceptance of this proposal by the Commissions shall not be construed as an approval of the sureties named in this proposal and in case the sureties named in this proposal are not approved by the Commissions, the undersigned, within five (5) days after notice of disapproval or within such further period, if any, as may be prescribed by the Commissions, shall substitute the names of other sureties approved by the Commissions.

(3) If the Commissions shall notify the undersigned that this proposal is accepted, then if the undersigned shall fail within five (5) days thereafter or within such further period, if any, as may be prescribed by the Commissions to execute and deliver the contract or execute and deliver the said bonds, the undersigned may, at the option of the Commissions be deemed either to have made the contract or to have abandoned the contract.

And in the latter case the Commissions may give notice thereof to the undersigned and may thereupon proceed to make another contract with such, if any, of the original bidders as in the opinion of the Commissions it will be to the best interest of the States to contract with or may, with or without public advertisement, invite further proposals and the undersigned shall thereupon be liable to the States for all loss and damage sustained by the States by reason of such failure of the undersigned. Inasmuch as the amount of such loss and damage will be extremely difficult to ascertain, especially in view of the fact that the furnishing and installing of the Electrical Equipment is a part of the construction of the Holland Tunnel and that any delay in the furnishing and installing of the said Electrical Equipment may delay the construction and completion of said Holland Tunnel, it is expressly understood and agreed that such loss and damage shall be liquidated and paid as follows: The undersigned shall pay to the States the expense of such new advertisement, if any, and in addition thereto the sum of One thousand dollars ($1,000) for each and every day, except Sundays and legal holidays, that the States shall be delayed in entering into a contract for the furnishing and installing of said Electrical Equipment by reason of such failure of the undersigned, and in addition thereto the excess, if any, of the amount of the bid, calculated from the quantities and prices contained in the proposal, which the States shall accept and upon which they shall enter into a contract for the furnishing and installing of such Electrical Equipment over the amount of the bid calculated from the quantities and prices contained in this proposal of the undersigned; which sums are hereby agreed upon not as a penalty but as liquidated damages which the States will suffer by reason of such failure of the undersigned. And the invitation and information for bidders and this proposal shall constitute a contract binding the undersigned to pay to the States the loss and damage

sustained by the States by reason of such failure of the undersigned as aforesaid.

(4) At the time of the delivery of this proposal to the Commissions the undersigned will separately deliver two certified checks for the sum of Twenty thousand dollars ($20,000) each, one payable to the order of the Comptroller of the State of New York and one payable to the order of the New Jersey Interstate Bridge and Tunnel Commission. And the undersigned hereby assigns to the States the said sums so especially deposited by the delivery of such certified checks as security for the performance of the obligations of the undersigned under this proposal. It is understood that said checks are to be returned to the undersigned when the contract for the furnishing and installing of such Electrical Equipment is executed and complied with, unless all the proposals submitted in response to said invitation and information for bidders shall be rejected by the Commissions and in that case when such proposals are rejected, as provided in the invitation and information for bidders. In case the undersigned shall default in the performance of any of the obligations of the undersigned under this proposal, the States shall have the right to apply the amount so specially deposited or so much thereof as may be necessary as a payment on account of the damages sustained by the States by reason of such default as aforesaid and shall return the balance, if any, to the undersigned. If the amount of such damages shall exceed the amount of said sums so specially deposited, the undersigned shall promptly upon demand from the Commissions pay the amount of such excess to the States.

(5) A notice that this proposal has been accepted addressed to the undersigned by the Commissions as aforesaid shall forthwith, at the option of the Commissions, operate as against the undersigned as a complete making of a contract according to the form thereof as aforesaid,

with the blanks therein contained filled in according to this proposal.

(6) The Commissions may cause any notice intended for the undersigned to be delivered at Room No. ..... on the ..... floor of the building No. ..... in the Borough of ..... in the City of New York, or Room No. ..... on the ..... floor of building No. ..... in the City of ....., N. J. Such delivery shall be sufficient notice to the undersigned.

(7) There are no persons interested with the undersigned in this proposal except*

(8) This proposal is made without any connection with any other person making a proposal or bid for the same purpose and is in all respects fair and without collusion or fraud. No member or employee of the Commissions is interested directly or indirectly, as contracting party, partner, stockholder or otherwise in or in the performance of the contract or in the supplies, work or business to which it relates or in any portion of the profits thereof.

Dated, , 1926.

* Here insert the names and addresses of all persons interested with the bidder. If there are no such persons, strike out the word "except."

County of New York,
State of New York, } ss.:

being duly

sworn, says: I am*

the proposing contractor above named. I have read the foregoing proposal. The same is in all respects true.

* If the bidder be an individual do not fill in this blank; if the bidder be a partnership, insert "a member of the firm of
"; if a corporation, insert, "the (President or other officer duly authorized) of the Company."

SURETIES' CONSENT.

That for and in consideration of the sum of One Dollar ($1.00) lawful money of the United States, the receipt whereof is hereby acknowledged, and as an inducement for and in consideration of the receipt and consideration of the bid annexed hereto and for other valuable considerations,

consent and agree that, if the contract for which the preceding proposal is made, be awarded to

we will become jointly and severally bound as sureties for its faithful performance and will execute the bonds in the form annexed to this proposal in the sum of Two hundred thousand dollars ($200,000) when so required as herein provided:

And if said the

shall omit or refuse to execute such contract within five (5) days from the time when notified by the Commissions or if we refuse to execute such bonds within the same time, then, we will pay, without proof of notice on demand to the said Commissions, any difference between the amount of the foregoing proposal and the sum to which the person, persons or corporations, to whom the

contract shall be finally awarded, would be entitled to receive upon such completion, the amount of said difference to be calculated upon the estimated amount of work by which the bids are tested, plus the expenses of readvertising, if any, and a sum of One thousand dollars ($1,000) per day for each and every day, except Sundays and legal holidays, that the States shall be delayed in entering into a contract for the furnishing and installing of the Electrical Equipment as liquidated damages:

If we refuse to execute such bonds as aforesaid, then, the Commissions shall at their election, have the right to pursue any remedy at law or in equity, including an action for specific performance to compel the execution of such bond.

In witness whereof, the undersigned have signed this agreement (or the undersigned corporations have caused this agreement to be signed by their proper officials and their corporate seals to be hereto affixed) this
day of , 1926.

(Attach acknowledgements and statements of surety companies here.)

SURETIES' CONSENT

State of .....
County of ..... } ss.:

On this .....day of .....,.....
1926, before me personally came .....
.....
.....
.....
.....
to me known and known to me to be the same person described in and who executed the foregoing consent, and ..... acknowledged to me that..... executed the same for the purpose therein mentioned.

.....

.....
(Title)

NOTE.—If the sureties are householders, the word "house" must be written in the following directions; if freeholders, the word "free" must be written. Each of these depositions must be signed by one of the proposed bondsmen and sworn to.

Additional blanks, if needed, will be furnished upon application to the Secretary.

State of .....
County of ..... } ss.:

The above-named .....
being duly sworn, says that he is a.....holder in
.....
that he resides at .....
.....
and is worth the sum of.....
..... dollars ($.....)
being..... the amount of security required for the completion of the contract above referred to, over and above all his debts of every nature, over and above his liabilities as bail, surety, or otherwise, and over and above all his property which is exempt by law from execution; and that he has offered himself as a surety in good faith, and with an intention to execute the bond required by law.

The following is a complete statement of all the deponent's assets and liabilities:

.....

Subscribed and sworn to before me this
..... day of ....., 1926.

.....

.....

(Title)

NOTE.—If the sureties are householders, the word "house" must be written in the following directions; if freeholders, the word "free" must be written. Each of these depositions must be signed by one of the proposed bondsmen and sworn to.

Additional blanks, if needed, will be furnished upon application to the Secretary.

State of .....
County of ..... } ss.:

The above-named .....
being duly sworn, says that he is a.....holder in
.....
that he resides at .....
.....
and is worth the sum of.....
..... dollars ($.....)
being..... the amount of security required for the completion of the contract above referred to, over and above all his debts of every nature, over and above his liabilities as bail, surety, or otherwise, and over and above all his property which is exempt by law from execution; and that he has offered himself as a surety in good faith, and with an intention to execute the bond required by law.

The following is a complete statement of all the deponent's assets and liabilities:

.....

Subscribed and sworn to before me this
..... day of ....., 1926.

.....

.....

(Title)

NOTE.—If the sureties are householders, the word "house" must be written in the following directions; if freeholders, the word "free" must be written. Each of these depositions must be signed by one of the proposed bondsmen and sworn to.

Additional blanks, if needed, will be furnished upon application to the Secretary.

State of .....
County of ..... } ss.:

The above-named .....
being duly sworn, says that he is a.....holder in
.....
that he resides at .....
.....
and is worth the sum of.....
..... dollars ($.....)
being..... the amount of security required for the completion of the contract above referred to, over and above all his debts of every nature, over and above his liabilities as bail, surety, or otherwise, and over and above all his property which is exempt by law from execution; and that he has offered himself as a surety in good faith, and with an intention to execute the bond required by law.

The following is a complete statement of all the deponent's assets and liabilities:

.....

Subscribed and sworn to before me this
..... day of ....., 1926.

.....

.....

(Title)

INDEX

Printed in the United States by the Appeal Printing Company
22 Thames Street, New York